On Extraction of TEETH

WOODBURN

ON EXTRACTION

WITH NOTES ON THE ANATOMY AND PHYSIOLOGY

OF THE

TEETH

FOR MEDICAL STUDENTS

ON EXTRACTION,

WITH NOTES ON THE ANATOMY AND PHYSIOLOGY,

OF

THE TEETH,

For Medical Students.

BY

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PREFACE.

In offering these notes on the teeth to medical students, I do so with a feeling of trepidation, recognising the largeness of the subject and the great number of excellent works on dentistry. Yet I feel that this little book will fill a gap in dental literature. I know of no recent concise book for the assistance of *medical* students on the teeth, a subject which, while intimately associated with their future professional lives, is only superficially glanced at in their student days.

The important part the teeth play in the human economy, the extent and worth of contemporary dental literature, and the ever-increasing facilities demanded for the special education of dental students, need not be emphasized. Yet there exists in general medical education a tendency to ignore the consideration which the teeth deserve. Hence it is for the use of *medical* students that these notes are offered. They are to a large extent the outcome of a careful study of

the most authoritative works on dental science. The only originality claimed is in the part relating to extraction, and those chapters are offered with all deference to the teaching and methods of others. In them I have merely submitted modes of procedure which, in my own experience, have been attended with the best results.

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CHAPTER I.

DEVELOPMENT.

HUMAN dentition, when complete, presents for description fifty-two teeth. These are divided into two distinct sets: first, temporary, deciduous or milk teeth, which are twenty in number, and are sufficient for the requirements of early childhood; and second, permanent teeth, which are thirty-two in number, and are so constructed and arranged as to meet the demands for proper mastication from childhood to adult life.

The following formulæ will show how these fifty-two teeth are divided and classified:

$$\text{Permanent—I. } \frac{4}{4} \text{ C. } \frac{2}{2} \text{ B. } \frac{4}{4} \text{ M. } \frac{6}{6} = 32.$$

$$\text{Temporary—I. } \frac{4}{4} \text{ C. } \frac{2}{2} \text{ M. } \frac{4}{4} = 20.$$

It will be seen that the deciduous incisors and canine teeth are merely reduplicated in the temporary set.

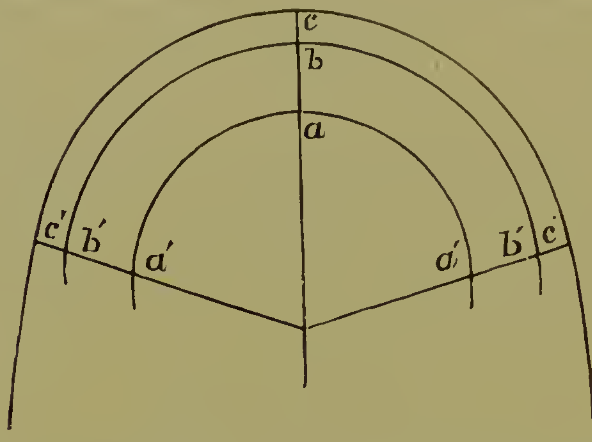


FIG. 1.—DIAGRAM ILLUSTRATING THE CHANGES IN THE DENTAL ARCH DURING THE GROWTH OF THE UPPER JAW.

a, Lowest point in the junction of the anterior portions of the two segments of the upper jaw, from a fœtus in the seventh month ; *b*, central point of the space between the edges of the two central incisors of a set of milk teeth ; *c*, the same of a permanent set ; *a'*, posterior and external termination of the alveolus of the second milk molar ; *b'*, point of intersection of the posterior coronal with the masticating surface of the second milk molar ; *c'*, point of intersection of the posterior coronal with the masticating surface of the second permanent bicuspid. *Natural size.* (Wedl.)

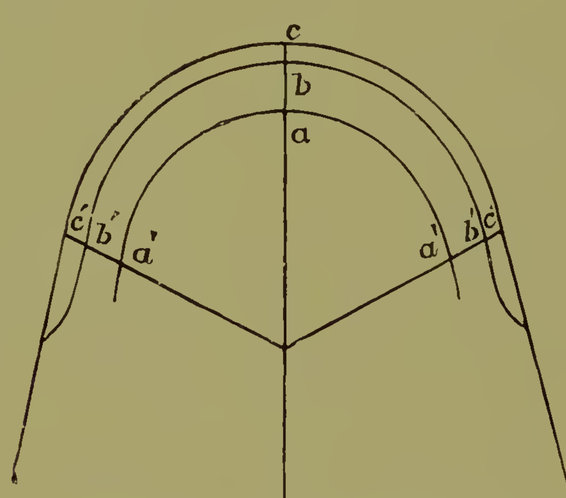


FIG. 2.—DIAGRAM ILLUSTRATING THE CHANGE IN THE DENTAL ARCH DURING THE GROWTH OF THE LOWER JAW.

a, The highest point in the line of junction of the anterior surfaces of the two segments of the lower jaw in a fœtus of seven months. The rest of the letters indicate corresponding points with those in the last figure. *Natural size.* (Wedl.)

Also that there are three teeth on either side and in each jaw in the permanent set, which are not represented in

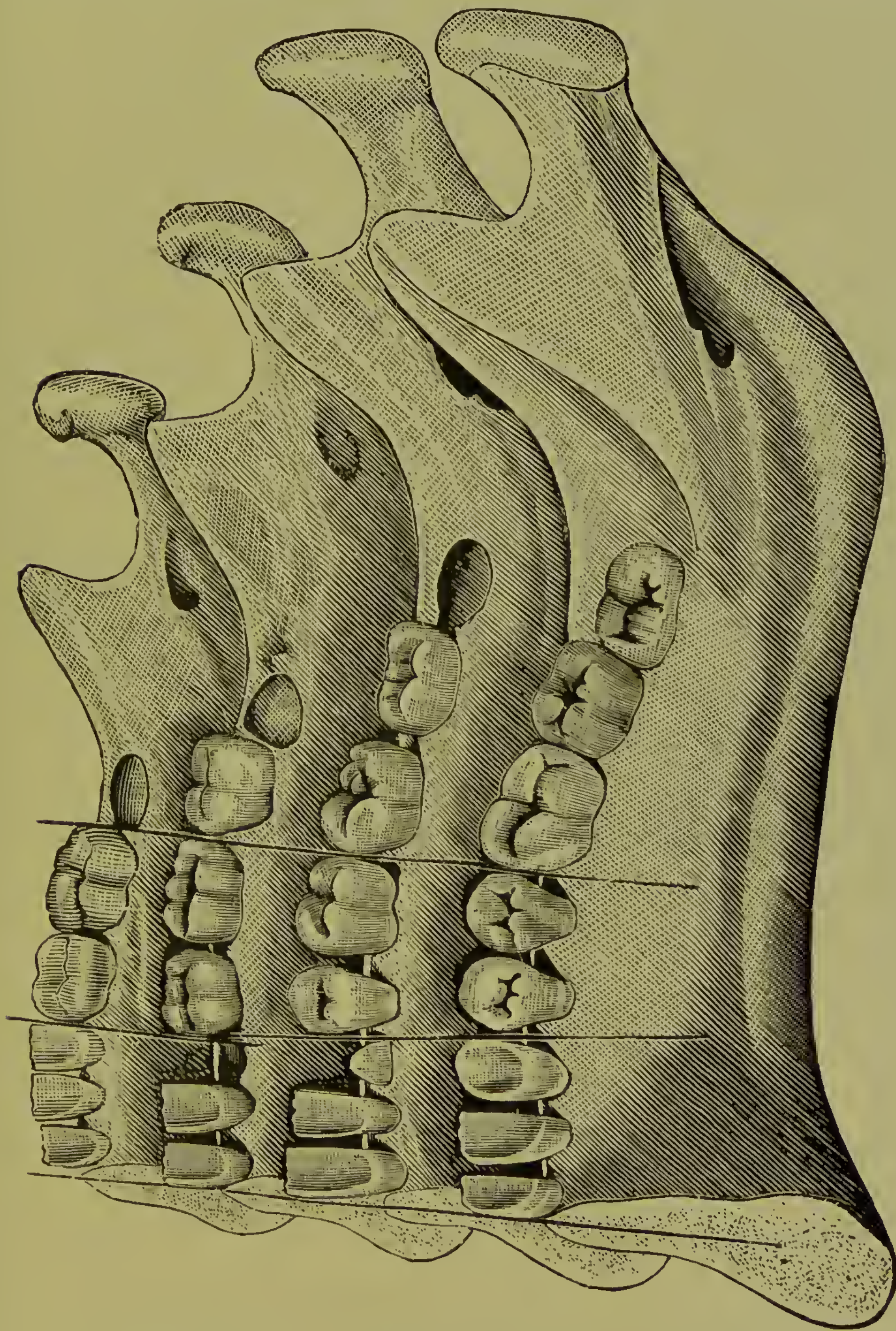


FIG. 3.—SHOWING BACKWARD DEVELOPMENT OF LOWER JAW.

the temporary set. Still further, that there are no premolars (bicuspids) in the temporary set, but that the

premolars take the place of the molars of the deciduous teeth. The permanent teeth are larger and more in keeping with the requirements of mature life than the temporary teeth. In order to meet this increase in size and number, the jaws become enlarged. This enlargement takes place in two directions. First, the arch of the jaws becomes expanded by a periosteal deposit on the outer plate of the alveolus, and a corresponding resorption of the inner plate. Second, a gradual development backward of the coronoid process takes place as the result of the increased demand for space by the erupting permanent molars, assisted by the action of the muscles of mastication and deglutition at this period of life coming into greater demand, by the increase in points of insertion of these muscles. This backward increase is well shown by the accompanying drawings (Figs. 1, 2, 3).

Some writers assert that the increase is due to interstitial growth, a controversial point which it is not now necessary to discuss.

CHAPTER II.

DEVELOPMENT.

Before going into the details of the development of the tooth, and in order that the phenomena that appear may be understood, it will be advisable to enter for a little into the histology of the structures from which the 'dental organ' takes its origin.

There have been so many writers on this subject, and the nomenclature used by them for the different parts has been so varied, that this has been the means of confusing many readers, and has necessarily led to erroneous ideas being adopted as to the changes that take place.

Not only the differing names of the separate parts, but also the mode of their disposal, have rendered a clear conception of their development a very difficult task. Besides this, the works of the older writers which many read have to a certain extent been the means of spreading a great diversity of opinion on the subject. However, recent writers have corrected these misconceptions by showing that these differences were brought about merely by the want of proper means of preparing specimens.

The 'mucous membrane' and the 'skin' are anatomically the same, the only difference being that the one lines the internal surface of the body, and the other the external. The subdivision of the separate layers of this cellular structure into a tabulated form is absolutely essential before the changes that follow in

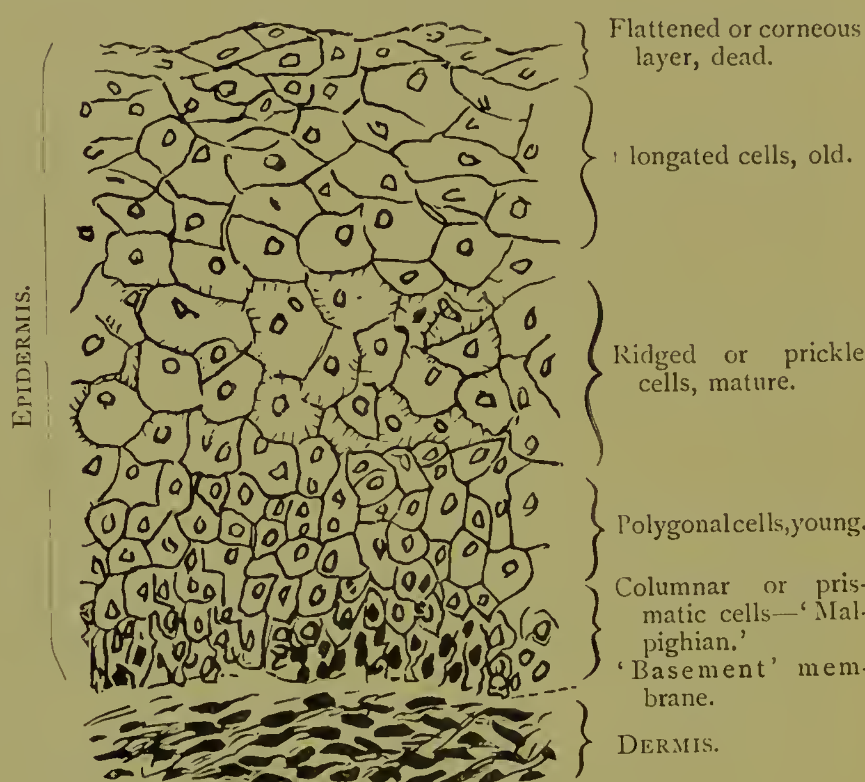


Fig. 4. (Diagrammatic.)

the development of the tooth can be thoroughly understood and appreciated. The mucous membrane or skin is, for descriptive purposes, divided into two distinct layers—the 'epidermis' and the 'dermis'—having between them a distinct divisional element not quite understood, and termed the 'basement' or 'intermediate' membrane (Fig. 4).

The 'epidermis' is purely epithelial in structure, and is of great importance, as the tooth development *takes its origin from it* (Fig. 4).

The 'dermis,' which lies subjacent to the epidermis, is in structure connective tissue, and is also of great importance, as the dentine structure of the tooth and the cementum *take their origin in it* (Fig. 4).

The 'basement,' or intermediate membrane, which lies between, is an amorphous substance not yet quite understood, and even its actual presence is disputed by many. It is of great interest, as the two developmental centres of the tooth *take place on either side of it* (Fig. 4).

The 'epidermis,' or epithelial layer, which lies between the free surface of the mucous membrane and the intermediate membrane, is composed of strata of epithelial cells in different stages of age and shape (Fig. 4).

These strata are divided into two distinct divisions: first, the 'corneous layer,' which is composed of old and dead epithelial cells, and is termed the true cuticle, or part that would be raised on the formation of a blister; and second, the 'Malpighian layer,' which is composed of young cells in active life, and is of special note, as this layer is the origin of the enamel organ of the tooth (Fig. 4).

Passing from within outwards, we find that the cells in the first layer (this Malpighian layer of infant cells) are columnar in shape, and in close apposition, having a distinct nucleus, but no defined cell-wall. Then

occurs a layer of maturer cells, or ridged cells, with a defined cell-wall and nucleus ; then a layer of older cells, polygonal in shape, with distinct nucleus, and adapted to one another in regular form ; then old cells, which have become elongated or flattened, with a very indistinct nucleus ; and, lastly, dead cells, which are merely scales, and ready for being cast as useless (Fig. 4).

All these layers are merely different stages of age of the original infant cell, which passes through its cycle and becomes useless, and is thrown off.

It is to the lower layer of the epidermis that we must turn, and which we must understand, in order to follow the first stage in the developing tooth. This layer is composed of prismatic or columnar shaped cells, set, as it were, on their ends, standing on the basement membrane, having a very distinct nucleus, but no apparent cell-wall. They seem to be set in a regular row, and assume a very marked prismatic shape.

The 'dermis,' or true mucous layer, lies subjacent to the epidermis and below the basement membrane, and is composed of a fibro-connective tissue, highly vascular, having tufts or bulbs of vessels in its substance, which give it the appearance of submerged papillæ. Hence it is sometimes called 'papillary layer.'

This tissue gradually merges into the subdermal or areolar tissue, with which it is in continuity. The 'dermis' is divided into two distinct parts : the 'papil-

lary,' as I have mentioned before; and the 'reticular' part, which is composed principally of a mass of net-work tissue.

The 'dermis' is of great importance, as it gives origin to the dentine germ. (Some writers say that the papilla rises from the surface of the dermis immediately below the basement membrane, and stands as an elevation; while others maintain that the dental centre of development originates in the dermal tissue.) If the arrangement of these separate parts be understood, the subsequent development of the tooth from them can be easily followed. Their respective positions one to another must be borne in mind, in order to understand a sectional view of the tooth-germ in its different stages of development.

No matter to what extent these separate parts be moved in the process of the development of the tooth, they always retain their respective relations. As a concluding remark, I might repeat that, on a section being made just prior to the commencement of the development, the order of the separate layers is, from above downwards: First, a layer of dead effete cells (flattened epithelial cells); second, layers of polyhedral and ridged cells in a maturer state; third, a layer of infant cells distinctly prismatic or columnar in shape; fourth, a dividing membrane, termed 'the basement membrane'; and fifth, the dermis, composed of connective tissue, and highly vascular.

At the end of the second month of embryonic life, if the surface of the jaw be examined, there will be found

a distinct elevated ridge ('dental ridge') running the entire length of it. This is composed of a large quantity of epithelial cells heaped on one another, showing that something evincing an increased activity is taking place in direct line with this elevation.

At this period the first stage of development commences by the Malpighian layer of infant columnar epithelial cells dipping downwards in a looped form into the dermal tissue. If a section (transverse) of the jaw be made at this time, it will be found that this looped process is forcing its way into the dermal tissue, not in a direct vertical line, but with a slight inclination inwards. This runs the entire length of the jaw, and is subsequently divided into separate centres for each tooth by the development of the 'follicular' wall, which will be described further on.

This process, in its downward movement, carries between its layers a quantity of the ridged and polyhedral cells which were lying above the Malpighian layer.

The section of the jaw taken at this time, from the surface to the deepest portion of the process, presents very much the appearance of a narrow flask (made of columnar epithelial cells placed together in regular form), filled with ridged and polyhedral cells, and then heaped up, having the flattened and elongated cells on the top (Fig. 5). When this process has reached the required depth necessary for the developing tooth by the activity of infant cell growth, it assumes a bulbous shape, while at the same time the two layers of the

columnar cells at the upper part coalesce and form a neck or cord, which communicates with the epidermis.

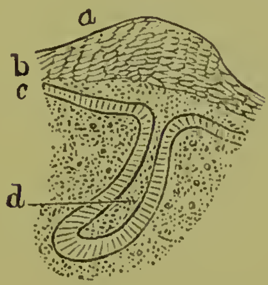


FIG. 5.

a, Dental ridge ; *b*, epithelial cells ; *c*, Malpighian layer ; *d*, cord. (Frey's 'Histology.')

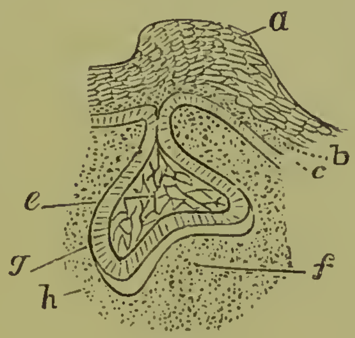


FIG. 6.

e, Stellate reticulum (enamel organ) ; *f*, dentinal papilla ; *g*, external epithelial layer. (Frey's 'Histology.')

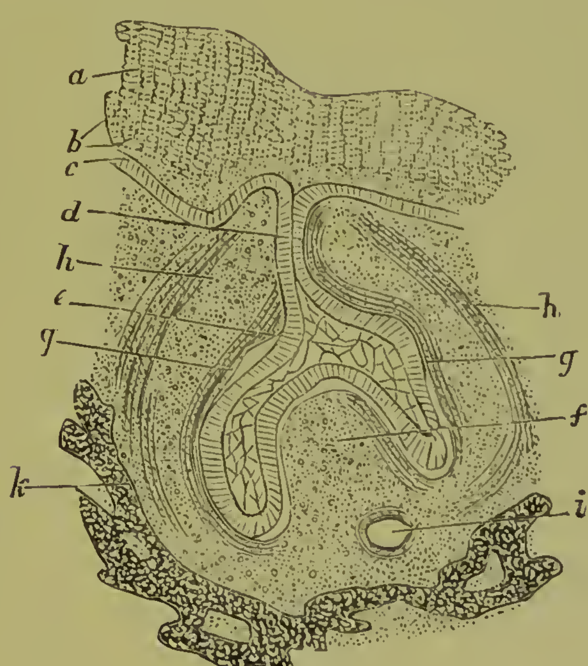


FIG. 7.

h, Connective-tissue casing ; *i*, section of vessel ; *k*, forming bone. (Frey's 'Histology.')

And now this process, which at first had very much the appearance of a section of tubular gland, has taken

a shape more like that of a Florence flask, having the globe part filled with cells ; this is termed the 'enamel organ' (Fig. 6). At this time the dental germ or bulb (called by some 'dental papilla') makes its appearance in the tissue immediately below the bulbous expansion of the enamel organ, and by its upward growth causes an invagination of the enamel organ (Fig. 7).

This enamel organ, which now rests on the dental bulb as a double cap or hood, is composed of an outer and an inner epithelial layer, having between them a protoplasmic mass and a large quantity of the epithelial cells which came down with the process. But they have now very much altered in appearance and form. The ridge cells have now changed their ridge appearance by having been compressed at parts, and have assumed a stellate form, the processes freely communicating with one another ; this is termed the 'stellate reticulum' of the enamel organ. The polygonal cells have become differentiated, and have assumed a regular position, lining the inner surface of the enamel organ ; this is termed the 'stratum intermedium.' The contents of this organ are termed the 'enamel pulp,' and it is from this mass of protoplasm and cells that calcification of the enamel cells takes place.

The 'dental germ' is a papillary mass of vascular gelatinous tissue, and is entirely derived from the dermis. It is highly vascular, and is composed of a network of nucleated cells.

This papillary mass, which at first was very indistinct, becomes defined, and as it grows upwards, its surface throws out small papillary elevations which

correspond to the number of the cusps of the tooth to be formed. On its surface defined cells make their appearance in close proximity to the internal epithelial layer of the enamel organ, which assume a definite shape and are arranged in a regular form. They are termed 'odontoblasts,' and in their turn become converted into 'dentine' by a process of calcification by conversion.

This odontoblast layer makes its appearance very early as an epithelial-like stratum of large columnar cells, which elongate at their outer extremity in the same manner as the prismatic cells of the enamel.

At this time an offshoot will be noticed from the epithelial neck of the enamel organ (precisely the same as the original process dipped from the Malpighian layer). This offshoot finds its way by degrees to the inside of the primary development, and serves as the commencement of the future permanent tooth; and the same process takes place in all the permanent teeth that have a corresponding temporary.

The first permanent molar takes its origin either from the cord of the developing second bicuspid or directly from the original lamina of oral epithelium. Some writers say that the second molar takes its origin from the process of the first, and the third molar from the process of the second. Other authorities maintain that each takes its origin directly from the Malpighian layer, and this theory has been partly proved by pathological conditions. But this is a controversial point which is still undecided.

The direction of the process of the molar teeth is

not quite the same as that of those with deciduous antecedents. For while the corresponding teeth pass inwards and downwards to assume a position behind and below the temporary, the molar processes pass backwards to their relative position in the developing jaw.

The next stage in the development is the formation of a connective-tissue casing, which springs from either side of the papillary base (on sectional view), and grows upwards towards the neck of the enamel organ, which it ultimately reaches and divides by meeting at that part, and so cuts off its contents from the epithelial surface. At this stage it assumes the form of a 'follicle,' and is termed the 'dental follicle' or 'sac.' This connective-tissue casing is termed the 'follicular wall' (Fig. 8, *a*).

Certain phenomena are observed in the formation of this follicle, with regard to the epithelial débris resulting from the severance of the cord. It is not necessary to enter on this point. Suffice it to say that there seems to be a proliferation of these cells, which find their way into different parts of the dermal tissue, and mostly become removed. But it is supposed that they may be the origin of perverted development of dental structures.

The tissue of the tooth-sac divides into two distinct layers—an outer and an inner. The inner represents the matrix from which the cementum is developed. The formation of cementum is similar to that of bone. The outer layer ultimately becomes the periosteum of the socket and the pericementum of the root.

We have now arrived at the follicular, which is practically the final, stage in the process of development prior to the conversion of the separate con-

Fig. 8.—'Dental Follicle.' (After Sudduth).

a, Follicular wall; *b*, external epithelial layer; *c*, internal epithelial layer; *d*, stellate reticulum or enamel pulp; *e*, odontoblasts forming dentine; *f*, pulp. (Diagrammatic.)

stituents into the structures forming the tooth and its associated tissues.

If we examine now a section of the dental follicle (Fig. 8), we can easily trace all the individual parts which are still in the same relationship to one another:

First, the follicular wall, which is a connective-tissue sacing arising, as before stated, from the papillary base, is ultimately divided to form the periosteum and the cementum of the root (Fig. 8, *a*).

FIG. 9.

(1) External epithelial layer ; (2) formed enamel ; (3) formed dentine ; (4) odontoblasts cells ; (5) pulp cells ; (6) stellate reticulum (enamel organ) ; (7) dental pulp (bloodvessels and nerves) ; (8) internal epithelial layer. (Diagrammatic.)

Second, the external layer of columnar epithelium, which forms the tooth cuticle, or skin of the teeth—Nasmyth's membrane (Fig. 8, *b*, and Fig. 9, 1).

Third, the stellate reticulum, or pulp of enamel organ (Fig. 8, *d*, and Fig. 9, 6).

Fourth, the intermediate layer of columnar cells (special), which ultimately disappear after the completion of enamel calcification (Fig. 9).

Fifth, the internal layer of columnar epithelium, which becomes specialized, and is converted into the enamel prisms (Fig. 8, *c*, and Fig. 9, 8).

Sixth, the 'basement membrane,' which is seen as a dividing line, and ultimately disappears. This is another controversial point among writers (Fig. 9).

Seventh, the odontoblast layer of cells, placed round the surface of the dental germ, and which is calcified into dentine by conversion, the cells themselves forming the matrix (Fig. 8, *e*, and Fig. 9, 4).

Eighth, the dentinal papilla, which is the pulp of the tooth, and is composed of connective tissue, highly vascular, and which finally becomes intersected with a large quantity of nerve fibrils (Fig. 8, *f*, and Fig. 9, 7).

These separate parts make their appearance at certain periods. But as the means of observation have been very difficult to obtain, these periods can only be given approximately :

	Temporary.	Permanent.
First appearance of enamel organ	7th to 8th week.	16th week.
First appearance of dental bulb...	9th week.	20th week.
First appearance of follicular wall	10th week.	21st week.
Closing of the follicle and rupture of cord	Beginning at 4th month.	9th month.

CHAPTER III.

TEMPORARY ERUPTION.

The eruption of the teeth is a process very little understood ; in fact, none of the theories put forward by writers on the subject have satisfactorily shown the actual means by which the teeth are moved forward in their sockets.

The theory of the addition of dentine, and consequent elongation of the fangs, as the cause of the eruption of the tooth is disproved by the fact that teeth with practically no roots at all have been erupted, and, further, that fully-formed teeth have remained in the jaw unerupted throughout life. Still further, it has been proved that the advance of the crown is not in proportion to the elongation of the roots, the crowns moving quicker. The actual impulse that pushes forward the teeth is a force independent of root elongation, but what that actual force is, is not precisely known.

At about the seventh month the bony crypts containing the temporary incisors become absorbed, the outer plate being removed a little earlier than the peripheral edge. When this process is sufficiently completed for the admission of the tooth, the forward

movement begins, and goes on without interruption till the eruption is complete. Coincident with the passage of the tooth out of its crypt, the absorption ceases and a reverse action takes place, and an addition to the alveolar process begins and goes on until its completion, when it closes round the neck of the tooth.

The process of eruption of the teeth, beginning with the incisors and going backwards, is not a continuous action. They are erupted in groups, having a period of rest of months between the different stages of the process. After the central incisors appear, come the lateral incisors about the ninth month. As a rule, the lower incisors make their appearance first.

Then follow the first molars about the twelfth month. During this period you will probably find most trouble during the period of *teething*, though some writers maintain that the eruption of the canines causes more annoyance. The canines succeed the first molars at about the eighteenth month. Then come the second molars about the twenty-fourth month. It has been observed that, as a rule, the upper molars make their appearance before the lower.

The following table gives approximately the dates of eruption and the order of the temporary teeth :

Central incisors	7th month.
Lateral incisors	9th ,,
First molars	12th ,,
Canines	13th ,,
Second molars	24th ,,

The approximate dates of the calcification of the temporary teeth are seen in Fig. 11.

CHAPTER IV.

ABSORPTION.

THE absorption of temporary teeth is a process in many ways similar to that of certain inflammatory affections. In bone the inflammatory action slowly disintegrates it and separates it from the surrounding healthy structure, reducing it into a condition readily removed by the natural channels. All the hard structures in the body are permeated by connective-tissue filaments, which yield nourishment to the part, and are the source of its vitality. In the tooth structure the same supply can be traced even into the enamel.

Absorption of the tooth (Fig. 10) always begins at the apex of the root, and steadily advances towards the gum level until nothing is left but the crown, and, in many cases, even only part of the crown. The actual cause of absorption was for a very long time not understood, but it has recently been very beautifully described in the investigations of Mr. Charles Tomes. His theory and his specimens showing the process are now universally accepted as correct. But the idea that this absorption was brought about by pressure from the advancing permanent tooth was

formerly held by many, and is even yet maintained by not a few. I have taken a series of measurements after the removal of partially-absorbed temporary

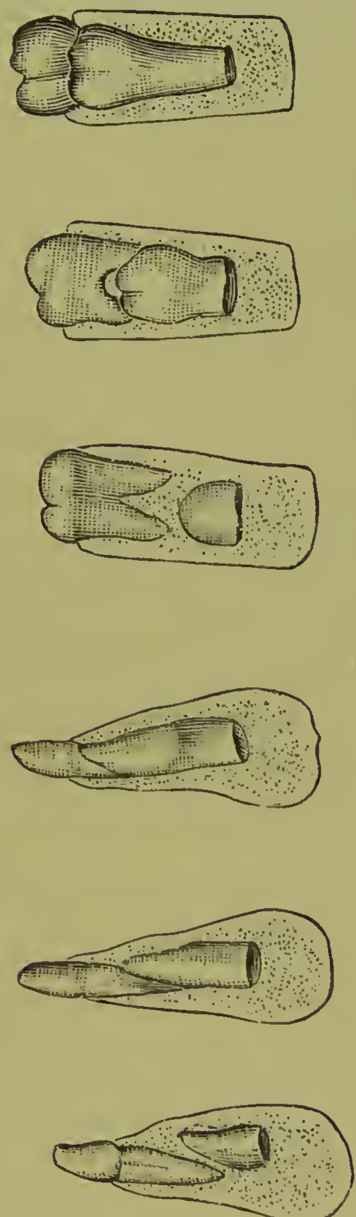


FIG. 10.

SHOWING THE RELATIONSHIP BETWEEN THE ERUPTING BICUSPID AND INCISOR OF THE PERMANENT TEETH AND THE DECALCIFYING INCISOR AND MOLAR OF THE TEMPORARY TEETH, IN THREE STAGES.

teeth, and have found that the length of root left, measured to the gum level, corresponds exactly, in most cases, to the distance between the crown of the permanent tooth corresponding and the gum level.

This shows that the rate of absorption is in proportion to the advance of the crown of the permanent tooth. It is not to be understood from this statement that the actual cause of absorption is brought about by the advance of the permanent tooth. But most certainly it is the case that the advance of the permanent tooth is the exciting cause of this process of absorption. The action of absorption begins as a necessity to admit of the coming tooth. Absorption, again, is not a continuous action. There are periods of rest in the process, and you will find that the temporary arrest of this action corresponds in some way with a slowing of the erupting permanent tooth or a temporary stopping of it, due, perhaps, to some systemic disturbance.

The cementum of the root is attacked first, then the dentine is assailed. On examination, deep semicircular depressions are found, which gradually increase in size, and ultimately join together. In the immediate vicinity of this tissue a large vascular mass will be noticed; this has been termed the 'absorbent organ.' It is covered on the surface with a large quantity of cells, termed 'giant cells' or 'osteoclasts.' One of these cells fits exactly into the semicircular depression formed in the cementum. It is owing to these cells that the hard tissues become reduced and removed, as they are always present when hard structures are being absorbed. How these cells actually bring about this disintegration of tissue is not quite understood, but it is either by their amœboid movement or else the cells themselves secrete an acid which dissolves the tissue.

These semicircular excavations, into which one of these myloid cells fits, have been termed the 'lacunæ of Howship.'

There is never any suppuration present, and there is no pain. There is a certain amount of redness and tenderness of the gum round the teeth ; but this is due to the ordinary increase of vascularity, which always accompanies a new growth or development.

There is no resemblance between this absorption of the dental tissue and caries. This absorption is a natural removal of a healthy structure ; while caries is the pathological removal of the same structure by means of a morbid process, and is caused by a chemical action, attended by the presence of bacteria, and consequently by putrefaction. Absorption always begins at or near the apex or root ; caries always begins from without.

The approximate dates of the decalcification of the temporary teeth are seen in Fig. 11.

CHAPTER V.

PERMANENT ERUPTION.

The eruption of the permanent teeth is similar in every way to that of their predecessors. The alveolar crypts rapidly become absorbed, and the outer plate disappears more quickly than the free edge. The crypts become very much opened, and allow of a very free exit for the teeth, so that no undue resistance to their advance is presented. The course of the teeth can now at this point be readily directed, so that the regulation of displaced teeth is an easy matter. As the teeth advance, the alveolar process of the temporary set becomes entirely swept away, and a new deposit takes place round the permanent ones, which is subject to their direction and eruption. No matter in what direction the tooth may go, the alveolus is found round it, and is entirely subservient to its development.

When the teeth are making their appearance through these wide-mouthed crypts, where there is no resistance, the lips and cheeks on one side and the tongue

on the other mould the arch required, and so regulate the teeth and keep them in position till the fixing takes place by the alveolus closing round their necks when the eruption is complete. In early childhood, when the permanent teeth are being erupted, if the child should suffer from enlarged tonsils or any naso-pharyngeal obstruction necessitating its breathing through the mouth, the extra pressure brought to bear by the muscular strain, owing to the mouth being continually kept open, causes a lateral compression, and gives the arch an elliptical shape, known as the V-shaped jaw.

When the eruption becomes complete, the upper and lower teeth antagonize mechanically, and adjust themselves till they form a perfect occlusion. It is a strange fact that, supposing any interference takes place, with the removal or eruption of one or more teeth, so that the occlusion is not perfect, they have the power of moving themselves to make up the difference, and so complete the normal arrangement, thus ensuring comfort and utility.

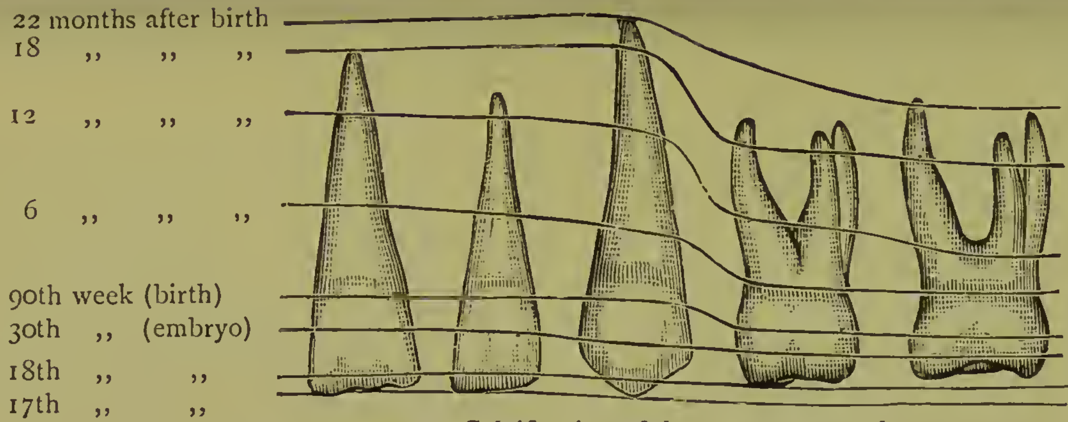
The first permanent teeth to make their appearance are the four first molars; then follow the central incisors; then the lateral incisors; then the first bicuspids. These are quickly followed by the second bicuspids; then come the canines; then the second molars; and lastly the third molars, or wisdom teeth.

The roots are not completed till about two years after the eruption of the teeth has taken place.

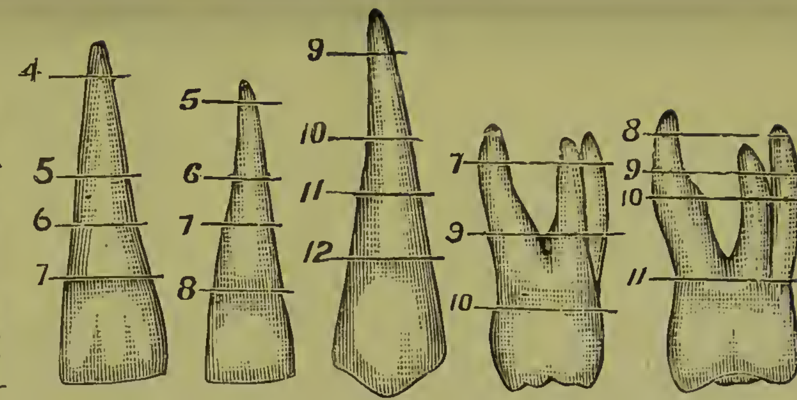
The following table gives an approximate idea of the dates of eruption of the permanent teeth :

First molars	6th to 7th year.
Central incisors	7th to 8th ,,
Lateral incisors	8th to 9th ,,
First bicuspids	9th to 10th ,,
Second bicuspids...	10th to 11th ,,
Canines	11th to 12th ,,
Second molars	12th to 14th ,,
Third molars	17th to 24th ,,

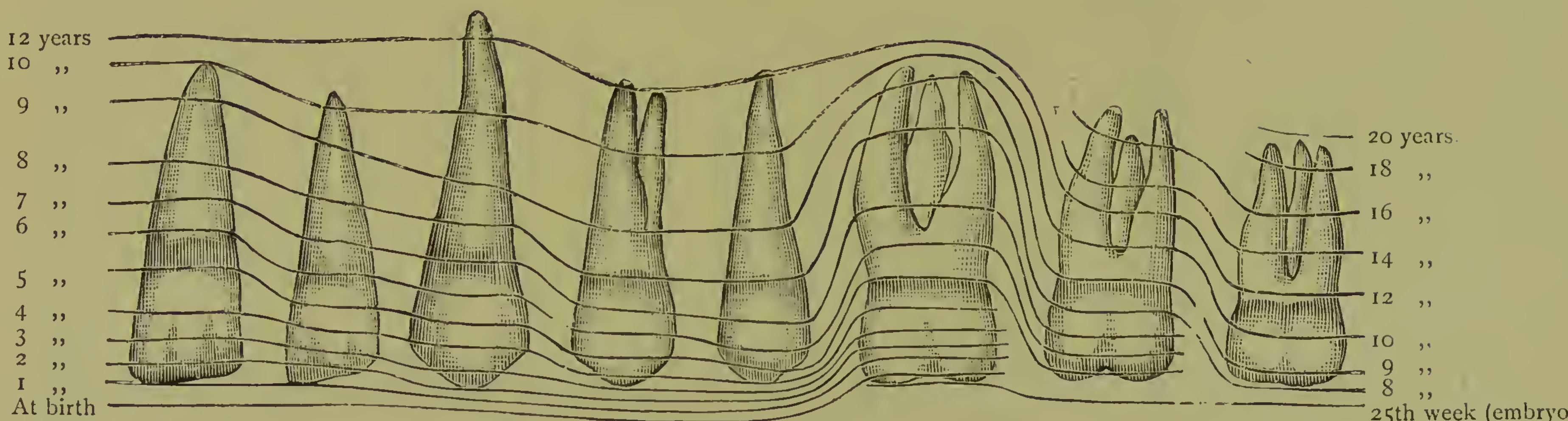
The approximate dates of the calcification of the permanent teeth are seen in Fig. 11.



Calcification of the temporary teeth.



Decalcification of the temporary teeth. The numbers indicate years.



Calcification of the permanent teeth.

FIG. 11.—CALCIFICATION AND DECALCIFICATION OF THE TEETH. (After Dr. Peirce.)

CHAPTER VI.

CARIES.

THE disease that invades the hard structures of the teeth has become universally termed 'dental caries'; but, when compared with caries of bone, the term does not quite convey an accurate description of what takes place. Attempts have been made to substitute for the word 'caries' the term 'decay,' but these efforts have not found much support. The term which is more descriptive of what actually takes place, and which cannot be confounded with any other process that attacks hard structures, is 'decalcification.'

The importance of this condition is of great moment to those who may at any time come in contact with it, not only because one is able to check its advance by proper treatment in its early stages, but because it is the progress of this decalcification that ultimately brings about a pulp exposure. This disease has been recognised from the very earliest times, and its etiology has been the field of research even from the days of Hippocrates. It is only within the last few years that a theory based on scientific facts has proved beyond doubt what is the cause of this decalcification. The theory now

accepted by nearly everybody is, that decalcification of the tooth structure is a chemico-parasitical action—that is to say, in the first instance there is an acid formation in the oral cavity which dissolves the calcific matrix from the enamel and exposes the dentine, which, in its turn, becomes subject to this acid solution ; and secondly, there is the formation of vegetable fungi, which assists in the calcic solution and ultimate disintegration of the tooth. It has been proved by experiment that the first stage of dental decalcification is brought about by acids, which are for the most part generated in the mouth, accompanied by the presence of micro-organisms. These micro-organisms are always found to be present in decalcified dentine, and have been observed to be the cause of various changes during this disease ; but it has been shown that the softening of the dentine goes in advance of the micro-organic invasion.

The acids which form in the oral cavity are the result of fermentation, and the fungi, which have the power to produce acid, are always present in the mouth. The acid produced by the assistance of those micro-organisms has been proved to be the ordinary ferment 'lactic acid,' which is brought about by the conversion of non-fermentable sugars into fermentable varieties, followed by the conversion of fermentable sugars into lactic acid. The fungi produce the invertine which converts non-fermentable sugar into invert sugar by taking up one molecule of water.

These fungi will not grow on surfaces that are

exposed to friction by the action of the lips and tongue ; hence the labial and lingual surfaces of teeth are seldom attacked. If these surfaces are attacked, it is, in most cases, as the result of some defect on their surface, which allows of the lodgment of the fungi. But on any surface where the lodgment of the fungi is protected their cultivation is rapid, as the medium in which they are placed is suitable in every way for their growth.

Approximal surfaces of teeth (surfaces facing one another), fissures naturally present in the teeth (such as those between the cusps of molars and bicuspids), and clefts abnormally produced or defects in the enamel structure (the result of retarded development), are the points where the decalcification of the teeth usually takes place.

The acid dissolves the calcific matter from the enamel and admits of the fungi, which can now carry on their work without interruption. The fungi have no power to attack or grow in anything unless spaces are offered for the lodgment of soft tissue. It is not the fungi themselves that attack the tooth structure, but their product (the lactic acid).

There are many other acids formed in the mouth, which no doubt act in part in this decalcification.

'Nitric acid' is formed by the decomposition of nitrogenous bodies.

'Sulphuric acid' is formed by the decomposition of albuminous substance.

'Hydrochloric acid' is present sometimes in the

mouth, owing to acid condition of the saliva or as caused by regurgitation from the stomach.

The predisposing causes of decalcification, apart from those mentioned, are principally hereditary, such as the transmission of malformed teeth from parent to child, or congenital defect from specific disease, which gives the teeth anatomical characters easily recognised.

Decalcification of the teeth is peculiar to the young. It is an undisputed fact that as age advances the chances of caries diminish. By the time the subject has reached the age of twenty, the largest number of cavities have formed, and if the teeth have withstood decalcification till that period, the probability is they will remain intact, unless some unusual condition takes place.

As a rule the teeth to be extracted are those that have been longest erupted, and the statistics given, which show this very well, are principally founded on cases of children and young people.

One Thousand Consecutive Cases in Western Infirmary.

Æt.		Æt.		Æt.		Æt.	
4	22	24	10	44	7	64	2
5	22	25	11	45	3	65	2
6	31	26	12	46	3	66	
7	48	27	13	47	1	67	1
8	78	28	10	48	4	68	
9	69	29	9	49	4	69	2
10	75	30	7	50	5	70	1
11	60	31	1	51	9	71	1
12	58	32	5	52	2	72	
13	51	33	4	53	3	73	1
14	37	34	6	54	2	74	1
15	30	35	5	55	4	75	2
16	38	36	6	56	2	76	1
17	32	37	5	57	1	77	
18	31	38	5	58	1	78	2
19	27	39	2	59	2	79	
20	21	40	9	60	5	80	1
21	21	41	5	61	1		
22	19	42	7	62	2		
23	12	43	5	63	3		

Æt. 4 to 20	730
„ 21 „ 30	124
„ 31 „ 57	115
„ 58 „ 80	31
	1000

Temporary.	Centrals.	Laterals.	Canines.	Bicuspids.	Molars.
325	30	53	36	79	477

CHAPTER VII.

DENTAL PULP AND PERIOSTEUM.

The dental pulp is a mass situated in the centre of the tooth, Fig. 12. Its shape bears a resemblance to the anatomical configuration of the tooth in which it lies. It is composed of bloodvessels and nerves, which for its size are very numerous, bound together by connective tissue.

The number of bloodvessels and nerves diminishes as the subject grows older, owing to a lessening in the size of the apical foramen. Consequently, in youth the pulp is much larger than in advanced age. The veins have very thin walls, in some places only endothelial cells, and in the arterioles there are found a few muscular fibres, circular and longitudinal.

The nerve of the pulp enters the apical foramen as a single branch, and at once divides into numerous branches, which are intimately connected by fine naked nerve filaments with the odontoblastic layer of cells on the surface of the pulp. These nerve fibrils are connected with the tubules of the dentine (Tomes) through the medium of this odontoblastic layer, and by this means sensations of pain are conveyed to the pulp from

without. The nerve-tissue of the pulp conveys sensations of pain. Under ordinary circumstances these painful sensations are aroused by thermal changes.

The 'periosteum' or 'pericementum' of the root is a delicate fibro-connective tissue lying between the root or roots of the tooth and its alveolar socket, and

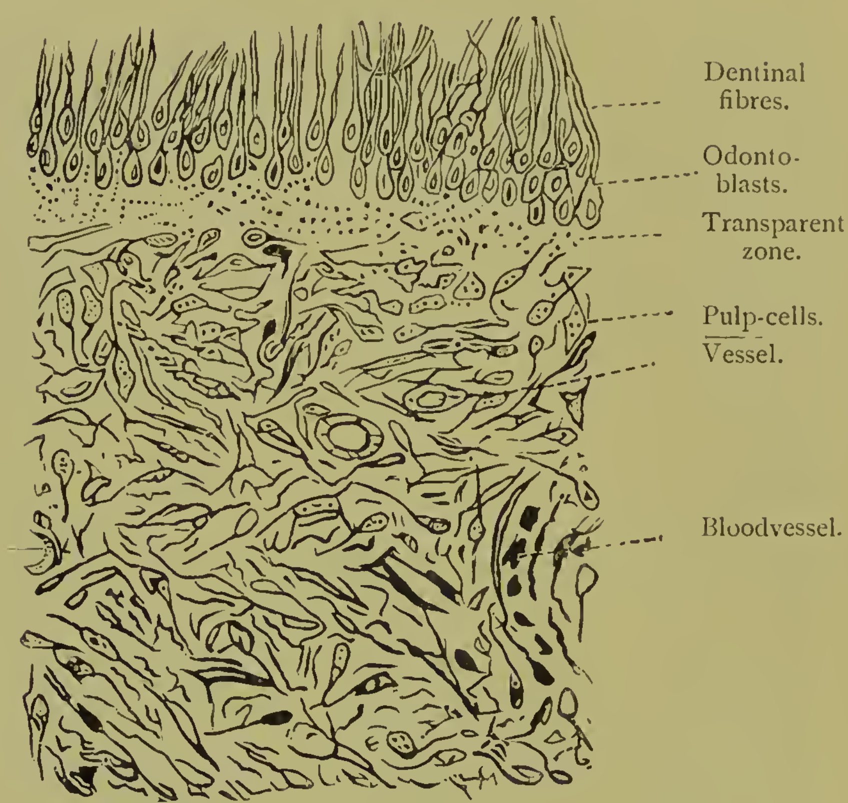


FIG. 12.—Section of Pulp. (Diagrammatic.) (After Dr. Black.)

completely filling up the space between them. That there is a space, and a large one, can be demonstrated by looking at a dry specimen, when the teeth will be found quite movable, and in many cases drop out.

The periosteum is highly vascular, and contains quantities of nerves. The vascular and nerve supplies come from the gingival branch, from branches from

the dental division passing into the root, and from the alveolar canals. This membrane is not of an even thickness, but is thicker and denser at the upper and lower ends, and thin at the middle. It can be divided into two distinct layers: an outer, which can be teased

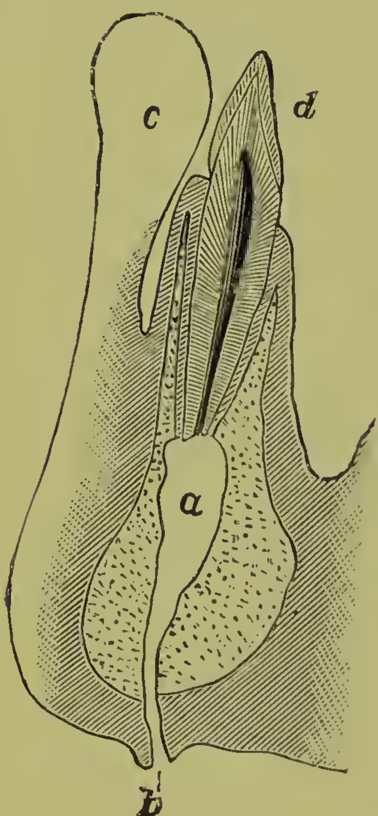


FIG. 13.

Chronic Alveolar Abscess of the Root of Lower Incisor, with abscess cavity passing through the body of bone, and discharging on the surface beneath the chin. (After Dr. Black.)

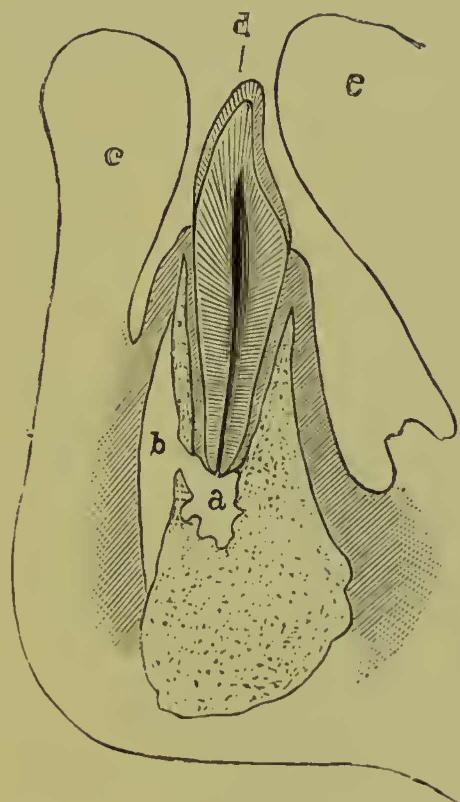


FIG. 14.

Acute Alveolar Abscess of a Lower Incisor, with pus cavity between the bone and periosteum. (After Dr. Black.)

into fibres; an inner, which is very dense, and contains no elastic fibres, and which acts as a pericementum to the roots.

It is the source of nourishment to the tooth. It acts as a pad or buffer for the modification of shock, and

allows of a certain amount of movement during mastication. It has on its surface, in close relationship to the cementum of the root, a row of specialized cells, termed 'cementoblasts'; and on its surface, toward the alveolar socket, there is another layer of specialized cells, termed 'osteoblasts,' each performing the function which their name implies.

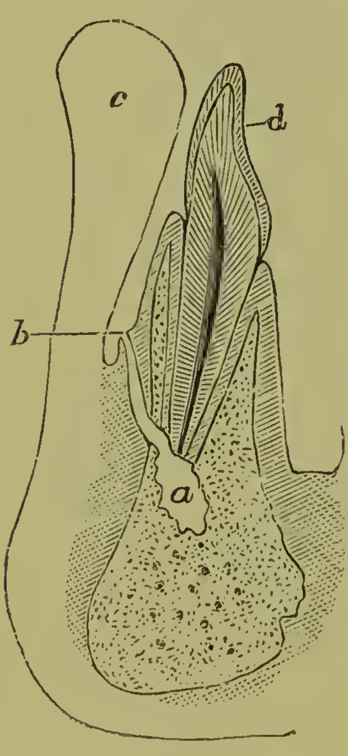


FIG. 15.

Chronic Alveolar Abscess at the Root of a Lower Incisor. (After Dr. Black.)

FIG. 16.

Acute Alveolar Abscess of the Lower Incisor, pointing on the gum. (After Dr. Black.)

The 'pathological' changes that take place in the first instance in the pulp tissue, and in the second place in the periosteal membrane, are the conditions which we have to contend with in cases of so-called 'toothache.' It will be evident, from the fact of the highly vascular and nervous consistency of these two structures, that

they are subject to the same conditions as other structures in the body of a similar formation. By decalcification of the tooth the pulp becomes exposed and receives a shock, which may be either from a sudden change of temperature, or by the application of an

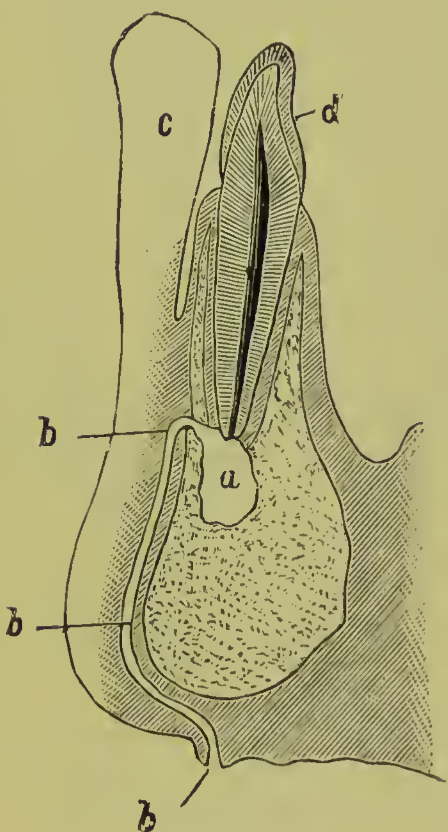


FIG. 17.

Chronic Alveolar Abscess at the Root of a Lower Incisor, with fistula discharging on the face and the chin—fistula following the periosteum of bone. (After Dr. Black.)

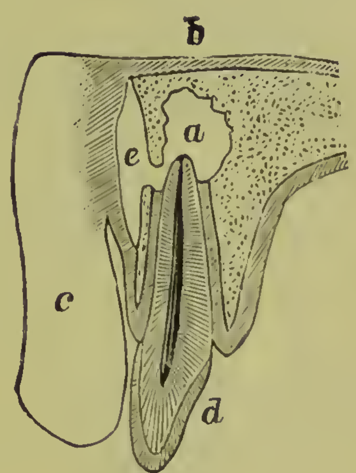


FIG. 18.

Acute Alveolar Abscess, with pus sac between the periosteum of bone. (After Dr. Black.)

irritant, or, what is most common, by something which is driven against or into it during mastication, probably some particle of food. As the result of this direct irritation, an inflammatory action is set up, and this inflammation proceeds by the usual changes accom-

panying other inflammations. The shock which is applied produces a paralysis of the vaso-motor nerves of the bloodvessels, and their muscular walls become

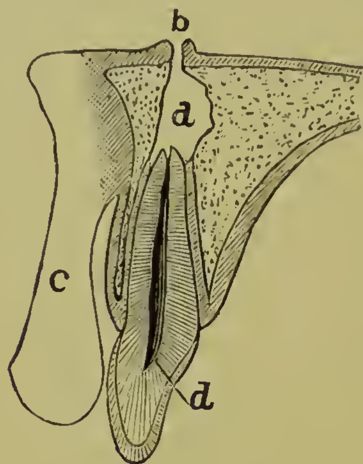


FIG. 19.

Alveolar Abscess at the Root of Upper Incisors, discharging into the nose. (After Dr. Black.)

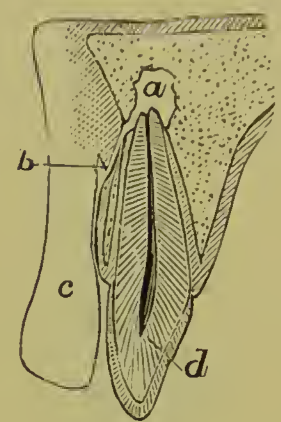


FIG. 20.

Chronic Alveolar Abscess at the Root of an Upper Incisor, with fistula on the gum. (After Dr. Black.)

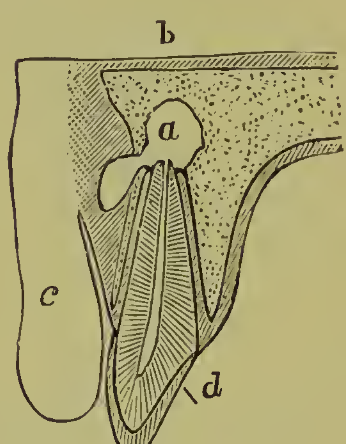


FIG. 21.

Acute Alveolar Abscess of Upper Incisor, pointing on the gum. (After Dr. Black.)

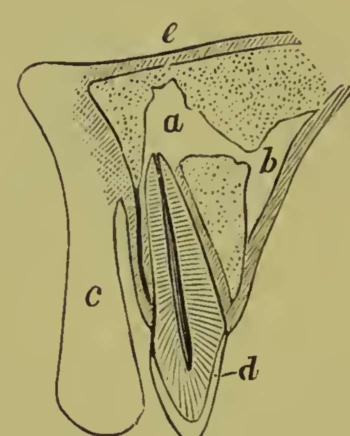


FIG. 22.

Upper Incisor, with Acute Alveolar Abscess. The pus has raised the periosteum from the hard palate. (After Dr. Black.)

relaxed, with a consequent dilatation of the vessel. The blood-flow becomes slow and increased in quantity, and the strange phenomenon takes place of the separa-

tion of the white corpuscles from the red. The red corpuscles appear to congregate in the middle of the stream, while the white corpuscles become slower and slower in their movement, then ultimately stop, and by their amœboid movement pass through the walls of the vessel into the surrounding tissue.

This exudation, as it increases, produces more and more pressure on the nerve fibrils, and, being confined

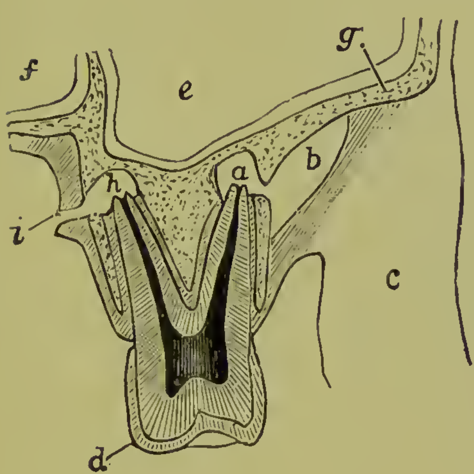


FIG. 23.

Upper Molar, with Acute Abscess at the Buccal Roots and Chronic Abscess at the Palatal Root. (After Dr. Black.)

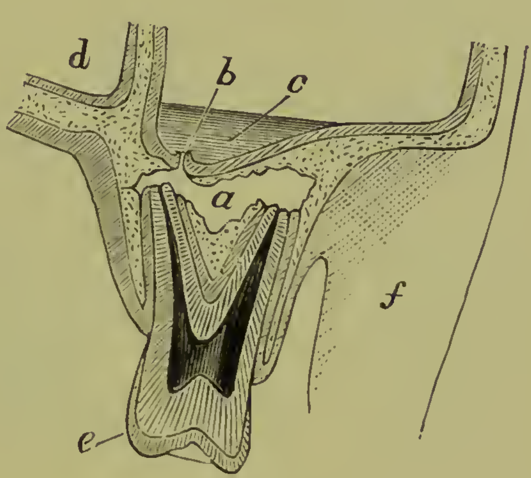


FIG. 24.

Alveolar Abscess at the Root of an Upper Molar, discharging into the antrum. (After Dr. Black.)

within a hard structure, the pain produced is of a throbbing nature synchronous with each beat of the heart, which is accelerated when the sufferer is in a recumbent position and warm, as when in bed.

This is true toothache, or pulpitis. It is easily recognised by the throbbing pain, which is relieved by the application of cold and increased by warmth.

This inflammatory action ends in the death of the

pulp by strangulation, and is followed by its decomposition, with the formation of pus and gases.

Then, by continuity of structure, an inflammatory action is set up in the periosteal membrane. Precisely the same phenomenon takes place here: a thickening of the membrane occurs, due to the exudation, which actually raises the tooth in its socket. This can be

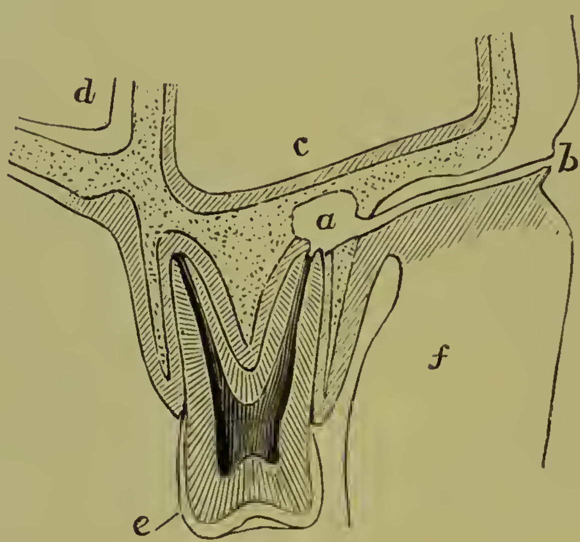


FIG. 25.

Alveolar Abscess at the Buccal Roots of an Upper Molar, discharging on the face. (After Dr. Black.)

easily recognised by the excessive pain which is produced by biting on the tooth affected.

An abscess sac is formed at the apex of the root or roots, which, as it becomes distended by the formation of pus, produces a resorption of the alveolar wall, as a rule in the line of least resistance. Then the abscess finds its way to the surface. This is termed 'alveolar abscess,' or, in more colloquial language, 'gum-boil.'

The drawings show the course, as a rule, taken by

pus from the respective teeth. But sometimes the pus finds its way underneath the cervical fascia, and its ultimate exit may be at a very remote distance. Some cases are recorded where the opening was over the sternum. Such a case occurred in my father's practice, and was cured by the removal of the tooth affected.

It is a daily experience in a hospital dispensary to find people with sinuses on the face and neck discharging pus freely.*

If the tooth which causes this condition be extracted at once, the cause is not only removed, but a natural drainage-tube is formed for the sac to empty itself.

* On inquiry into such cases, we are invariably told that they had had a swollen cheek at some time, and, being advised to poultice, the abscess had burst of itself, or had been opened by a surgeon.

CHAPTER VIII.

DENTAL ANATOMY.

The teeth are composed of four tissues: first, 'dentine,' which forms the body of the tooth, and is its main substance; second, 'enamel,' which encases the coronal part, and is its protective agent; third, 'cementum,' which encases the root or roots, and meets the enamel covering at the neck of the tooth; fourth, 'pulp,' which occupies the cavity in the dentine, and completely fills it.

For anatomical purposes the teeth may be divided into three parts: first, the 'crown,' which is the part projecting above the gum tissue, and is covered with enamel; second, the 'root' or roots, which are encased in the alveolar socket, and are covered with cementum; third, the 'neck,' which is the part at which the crown joins the root, and corresponds to the free edge of the gum.

The crowns may be divided into four kinds: first, chisel-shaped teeth for cutting purposes ('incisors'), eight in number; second, sharp-pointed teeth, or teeth with only one cusp, for seizing purposes ('canines'), four in number; third, oblong-shaped teeth, sur-

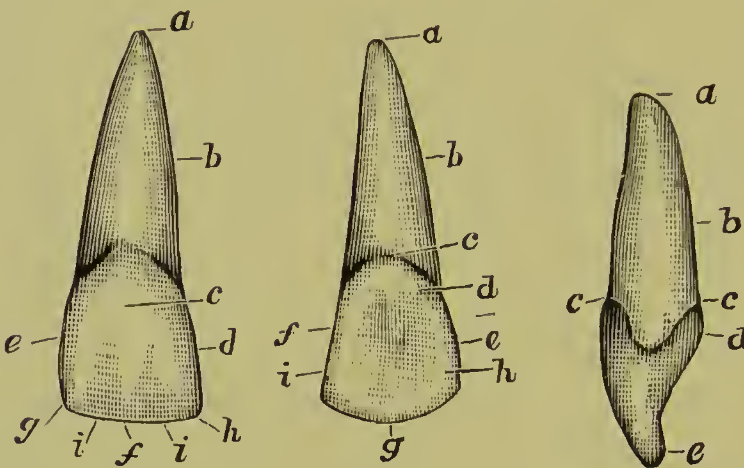
mounted by two cusps, for grinding and tearing purposes ('bicuspids'), eight in number; fourth, squarish-shaped teeth, having the corners rounded off and surmounted by a number of cusps, for grinding purposes ('molars'), twelve in number.

The roots may be either single (as in the incisors, canines, bicuspids) or double (as in lower molars), or there may be three roots (as in the upper molars), or an indefinite number (as in abnormalities). They may be round-shaped or cylindrical (as in the incisors of the upper jaw and upper molars), or they may be slightly flattened (as in the upper canines), or, again, they may be distinctly flattened (as in the lower incisors, canines, and upper and lower bicuspids and molars). They may have straight roots (as in the upper and lower incisors, canines, and bicuspids), or they may have curved roots (as in the lower molars), or they may be in part straight and in part curved (as in the upper molars).

The surfaces of the crowns of the teeth are named according to the relative position they bear to one another, to the cheek, to the lips and tongue, and to the middle line—viz., occluding or grinding surface, buccal surface, labial surface, lingual surface, mesial surface, distal surface.

INCISORS—*The Upper Central Incisors* (Fig. 26).—These are the largest of this group, the labial surface being convex and the lingual surface concave; the mesial surface is larger than the distal, and its junction with the cutting edge is at an acute angle, while the distal

surface forms an obtuse angle with it. The enamel in its labial and lingual surfaces terminates in a crescentic form, with the arch facing upwards towards the gum, and on the mesial and distal surface in a V-shape, having the apex of the V looking downward away from the gum.



(1) (2) (3)

FIG. 26.

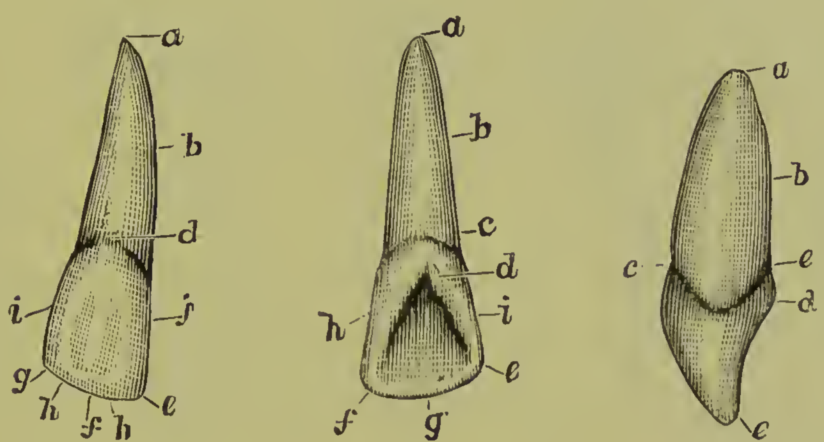
(1) Right Upper Central Incisor, Labial Surface. *a*, Apex of root; *b*, body of root; *c*, labial surface; *d*, mesial surface; *e*, distal surface; *f*, cutting edge; *g*, distal angle; *h*, mesial angle; *i*, labial grooves.
(2) Right Upper Central Incisor, Lingual Surface. *a*, Apex of root; *b*, body of root; *c*, gingival line; *d*, lingulum; *e*, distal surface; *f*, mesial surface; *g*, cutting edge; *h*, distal marginal ridge; *i*, mesial marginal ridge.
(3) Right Upper Central Incisor, Mesial Surface. *a*, Apex of root; *b*, body of root; *c*, gingival line; *d*, gingival ridge; *e*, mesial angle.

The root is round and straight, and the pulp bears a resemblance to the anatomical formation of the tooth.

The Upper Lateral Incisors (Fig. 27).—These are smaller than the centrals, but bear a great resemblance to them. The tubercle, which is present at the upper part near the gum on the lingual surface, is more developed than in the centrals, and is a favourite spot for decalcification.

Lower Central Incisors (Fig. 28).—These are smaller than the upper incisors, and are also smaller than the lower lateral incisors; they have a cutting edge nearly level, the two angles being both acute. The roots are very much compressed laterally.

Lower Lateral Incisors (Fig. 28).—These are very similar to the central, except that they are considerably



(1) (2) (3)

FIG. 27.

(1) Right Upper Lateral Incisor, Labial Surface. *a*, Apex of root; *b*, body of root; *d*, gingival line; *e*, median angle; *f*, cutting edge; *g*, distal angle; *h*, labial grooves; *i*, distal surface; *j*, mesial surface.
(2) Right Upper Lateral Incisor, Lingual Surface. *a*, Apex of root; *b*, body of root; *c*, gingival line; *d*, lingual pit; *e*, distal angle; *f*, mesial angle; *g*, cutting edge; *h*, mesial surface; *i*, distal surface.
(3) Right Upper Lateral Incisor, Mesial Surface. *a*, Apex of root; *b*, body of root; *c*, gingival line; *d*, linguo-gingival ridge and tubercle; *e*, mesial angle.

larger, and have the distal angle very much rounded off. The roots are very much compressed laterally.

CANINES—*Upper Canines* (Fig. 29).—These are the characteristic teeth of the face, situated at the angle of the jaw, and have the largest root of any of the teeth. They are the most important teeth in comparative dentology. In some of the lower animals they are developed to a great size, and are adapted for many

purposes, the most interesting being those of prehension, gnawing, locomotion, and defence.

The labial surface is concave, and has a slight ridge running from the gum level and terminating in the single cusp which surmounts the cutting edge. The cutting edge to the mesial side of the cusp is compara-

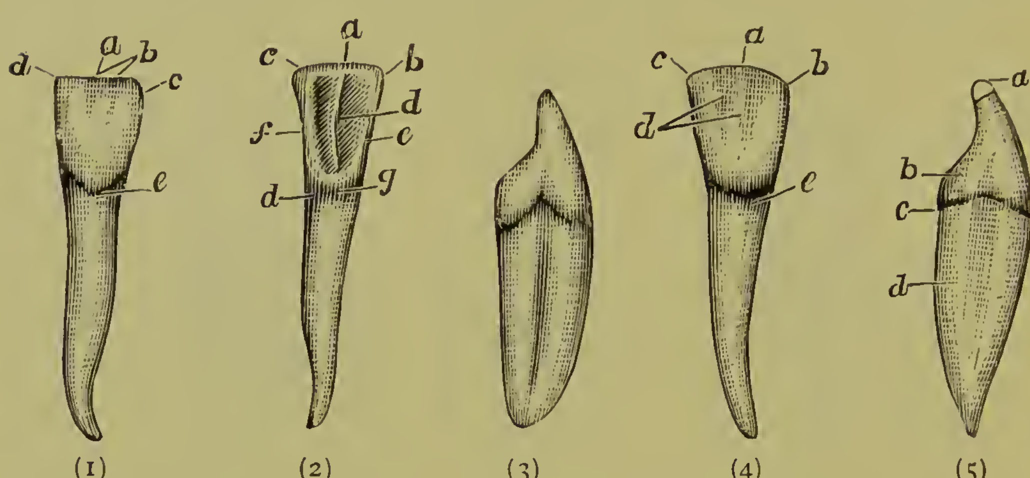


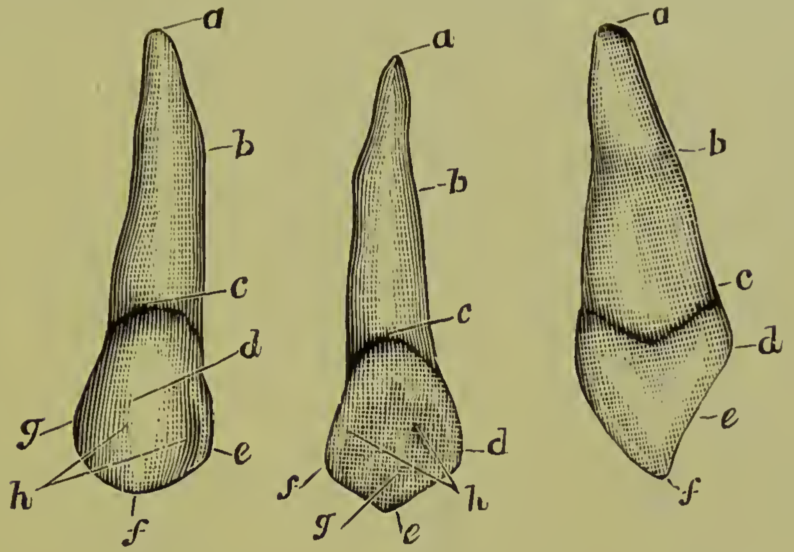
FIG. 28.

(1) Left Lower Central Incisor, Labial Surface. *a*, Cutting edge ; *b*, labial grooves ; *c*, distal angle ; *d*, mesial angle ; *e*, gingival ridge.
(2) Lower Central Incisor, Lingual Surface. *a*, Cutting edge ; *b*, mesial angle ; *c*, distal angle ; *d*, lingual ridge ; *e*, mesial marginal ridge ; *f*, distal marginal ridge ; *g*, linguo-gingival ridge.
(3) Lower Central Incisor, Mesial Surface.
(4) Left Lower Lateral Incisor, Labial Surface. *a*, Cutting edge ; *b*, distal angle ; *c*, mesial angle ; *d*, labial grooves ; *e*, gingival line.
(5) Right Lower Lateral Incisor, Distal Surface. *a*, Cutting edge ; *b*, linguo-gingival ridge ; *c*, gingival ridge ; *d*, deep groove in the root.

tively sharp, while the distal edge tapers gradually off. The lingual surface has also a longitudinal ridge, ending at the gum edge in a well-marked tubercle, similar to that on the lateral incisor.

The root is slightly compressed laterally, and is, as a rule, straight.

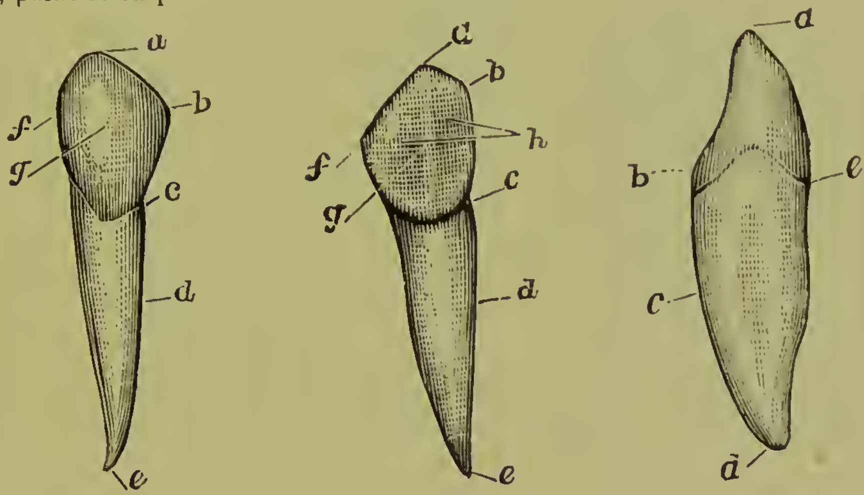
Lower Canines (Fig. 30).—These are very similar to



(1) (2) (3)

FIG. 29.

(1) Right Upper Canine, Labial Surface. *a*, Apex of root ; *b*, body of root ; *c*, gingival ridge ; *d*, labial ridge ; *e*, mesial angle ; *f*, point of cusp ; *g*, distal angle ; *h*, labial grooves.
(2) Right Upper Canine, Lingual Surface. *a*, Apex of root ; *b*, body of root ; *c*, gingival ridge ; *d*, distal angle ; *e*, point of cusp ; *f*, mesial angle ; *g*, lingual ridge ; *h*, lingual grooves.
(3) Right Upper Canine, Mesial Surface. *a*, Apex of root ; *b*, body of root ; *c*, gingival ridge ; *d*, linguo-gingival ridge ; *c*, mesial marginal ridge ; *f*, point of cusp.



(1) (2) (3)

FIG. 30.

(1) Left Lower Canine, Labial Surface. *a*, Point of cusp ; *b*, distal angle ; *c*, gingival ridge ; *d*, body of root ; *e*, apex of root ; *f*, mesial angle ; *g*, labial ridge.
(2) Left Lower Canine, Lingual Surface. *a*, Point of cusp ; *b*, mesial ridge ; *c*, gingival ridge ; *d*, body of root ; *e*, apex of root ; *f*, distal angle ; *g*, lingual ridge ; *h*, lingual groove.
(3) Left Lower Canine, Mesial Surface. *a*, Point of cusp ; *b*, linguo-gingival ridge ; *c*, body of root ; *d*, apex of root ; *e*, gingival ridge.

the upper, except that the ridge is not so well marked, and the roots are more compressed laterally.

PREMOLARS OR BICUSPIDS—*First Upper Bicuspids* (Fig. 31).—These are slightly larger than the lower. The labial surface is rather larger than the lingual. It is surmounted by two cusps, having a deep fissure

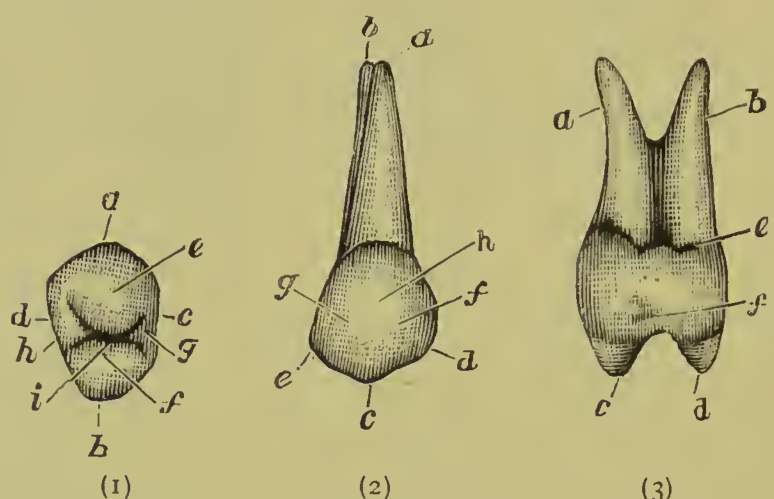


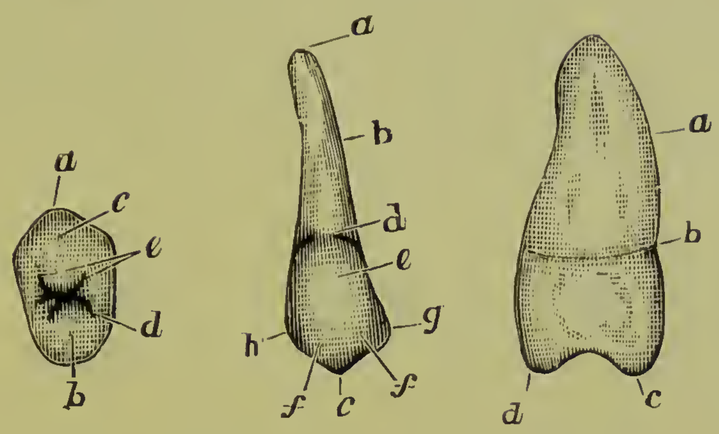
FIG. 31.

(1) First Upper Bicuspid, Grinding Surface. *a*, Buccal surface; *b*, lingual surface; *c*, mesial surface; *d*, distal surface; *e*, buccal cusp; *f*, lingual cusp; *g*, mesial marginal ridge; *h*, distal marginal ridge; *i*, transverse fissure.
(2) Right Upper Bicuspid, Buccal Surface. *a*, Apex of buccal bifurcation of root; *b*, apex of lingual bifurcation of root; *c*, point of buccal cusp; *d*, distal angle; *e*, mesial angle; *f* and *g*, buccal grooves; *h*, buccal ridge.
(3) Right Upper First Bicuspid. *a*, Buccal root; *b*, lingual root; *c*, buccal cusp; *d*, lingual cusp; *e*, gingival line; *f*, mesial angle.

dividing. The root is very much flattened laterally, is usually straight, and, as a rule, is bifurcated.

Second Upper Bicuspid.—This is very similar to the first in every way, except that the root is usually not bifurcated, although in many cases it is.

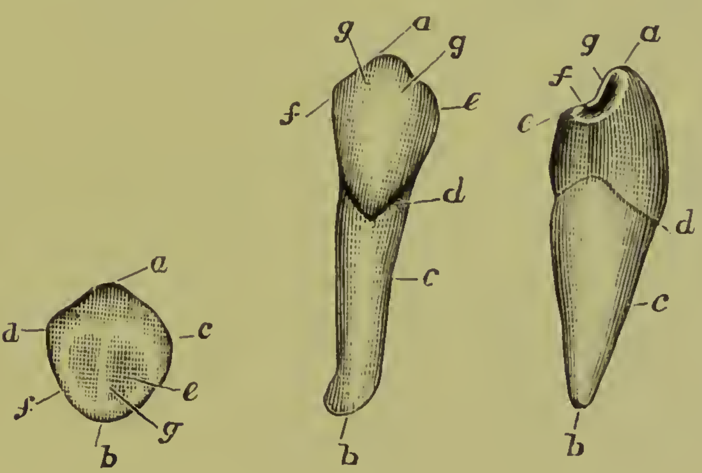
First Lower Bicuspid.—This has two cusps, but the lingual is very much smaller than the buccal, and bears a great resemblance to the canine tooth. These



(1) (2) (3)

FIG. 32.

(1) Right Upper Second Bicuspid, Grinding Surface. *a*, Buccal ridge ; *b*, lingual cusp ; *c*, buccal cusp ; *d*, central groove ; *e*, triangular grooves.
(2) Right Upper Second Bicuspid, Buccal Surface. *a*, Apex of root ; *b*, body of root ; *c*, point of buccal cusp ; *d*, gingival line ; *e*, buccal ridge ; *f*, buccal grooves ; *g*, distal surface ; *h*, mesial surface.
(3) Right Upper Second Bicuspid, Mesial Surface. *a*, Body of root ; *b*, gingival line ; *c*, lingual cusp ; *d*, buccal cusp.



(1) (2) (3)

FIG. 33.

(1) Right Lower First Bicuspid, Grinding Surface. *a*, Buccal ridge ; *b*, lingual ridge ; *c*, distal angle ; *d*, mesial angle ; *e*, distal pit or fissure ; *f*, mesial pit or fissure ; *g*, ridge passing from buccal cusp to lingual cusp.
(2) Right Lower First Bicuspid, Buccal Surface. *a*, Point of buccal cusp ; *b*, apex of root ; *c*, body of root ; *d*, gingival line ; *e*, mesial angle ; *f*, distal angle ; *g*, buccal grooves.
(3) Left Lower Bicuspid, Mesial Surface. *a*, Point of buccal cusp ; *b*, apex of root ; *c*, body of root ; *d*, gingival line ; *e*, lingual cusp.

two cusps are united by a distinct ridge, having a small fissure on both sides of it. The root is not quite so flattened as its neighbour in the upper jaw, and is quite straight (Fig. 33).

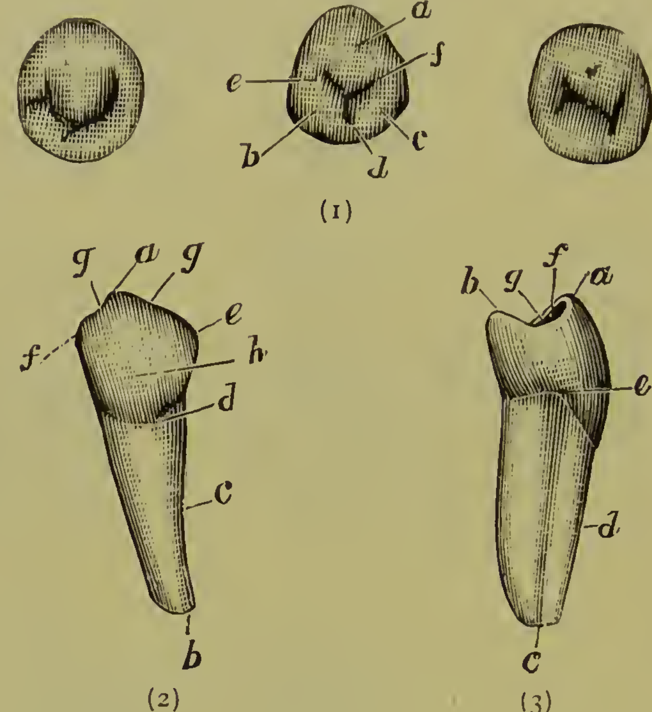


FIG. 34.

(1) Right Lower Second Bicuspid, Grinding Surface. *a*, Buccal cusp ; *b*, disto-lingual cusp ; *c*, mesio-lingual cusp ; *d*, lingual groove ; *e*, mesial groove ; *f*, distal groove.
(2) Left Lower Second Bicuspid, Buccal Surface. *a*, Point of buccal cusp ; *b*, apex of root ; *c*, body of root ; *d*, gingival line ; *e*, distal angle ; *f*, mesial angle ; *g*, buccal grooves ; *h*, buccal ridge.
(3) Left Lower Second Bicuspid, Mesial Surface. *a*, Point of buccal cusp ; *b*, point of lingual cusp ; *c*, apex of root ; *d*, body of root ; *e*, gingival line ; *f*, ridge of buccal cusp ; *g*, distal marginal ridge.

Second Lower Bicuspid.—This is very similar to the first, except that the lingual cusp is usually larger than the buccal. Very often this tooth presents a third cusp. The root is shaped like its fellow (Fig. 34).

MOLARS.—*The first and second upper molars* are very similar, except that the roots of the first are more

divergent than those of the second. The crowns are somewhat rhomboidal in shape, and are surmounted by four cusps: two to the buccal side, and two to the palate, the antero-palatal, which is the largest, being joined to the posterior buccal by an oblique ridge, on both sides of which is a deep fissure. They have three roots, two lying in an antero-posterior

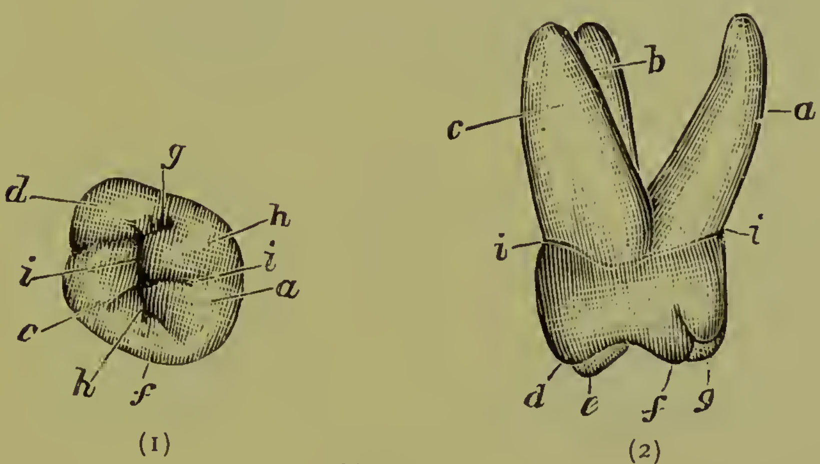


FIG. 35.

(1) Right Upper First Molar, Occluding or Grinding Surface. *a*, Mesio-buccal cusp; right *h*, disto-buccal cusp; *c*, mesio-lingual cusp; *d*, disto-lingual cusp; *f*, mesio-marginal ridge; *g*, disto-marginal ridge; left *i*, mesial groove; right *i*, buccal groove; left *h*, mesial groove.

(2) Right Upper First Molar, Mesial Surface. *a*, Palatal root; *b*, disto-buccal root; *c*, mesio-buccal root; *d*, mesio-buccal cusp; *e*, disto-buccal cusp; *f*, mesio-lingual cusp; *g*, disto-lingual cusp; *i*, gingival line.

position towards the buccal side, and one towards the palate. The buccal roots are flattened and straight, the anterior being the larger. The palatal root is cylindrical, and curved inwards and upwards

Third Upper Molars (Wisdom).—These have, as a rule, the roots fused into one, forming a cone-shaped root. They have three cusps, two of them placed towards the buccal side and one towards the palate.

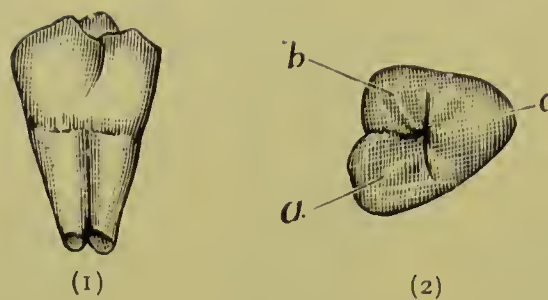


FIG. 36.

(1) Right Upper Third Molar, Buccal Surface.
(2) Right Upper Third Molar (Wisdom), Grinding Surface. *a*, Anterior buccal cusp ; *b*, posterior buccal cusp ; *c*, palatal cusp.

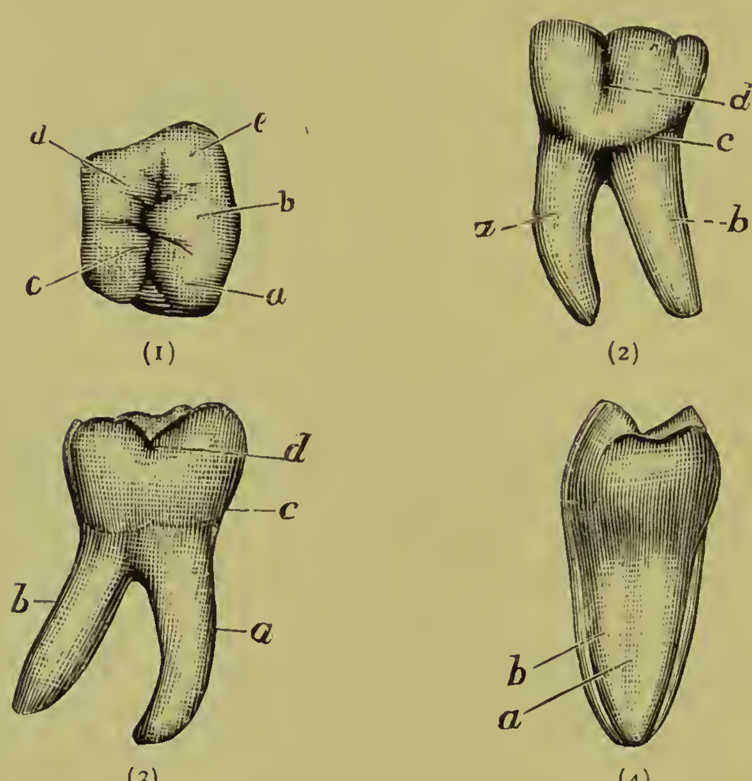


FIG. 37.

(1) Left Lower First Molar, Grinding Surface. *a*, Mesio-buccal cusp ; *b*, disto-buccal cusp ; *c*, mesio-lingual cusp ; *d*, disto-lingual cusp ; *e*, distal cusp.
(2) Left Lower First Molar, Buccal Surface. *a*, Anterior root ; *b*, posterior root ; *c*, gingival line ; *d*, buccal pit. (*Note.*—The buccal pit of this tooth is a common seat of decalcification.)
(3) Left Lower First Molar, Lingual Surface. *a*, Anterior root ; *b*, posterior root ; *c*, gingival line ; *d*, lingual groove.
(4) Left Lower First Molar, Distal Surface. *a*, Posterior root ; *b*, anterior root.

They vary very much in size and shape in different individuals (Fig. 36).

First Lower Molar.—The crown of this tooth is

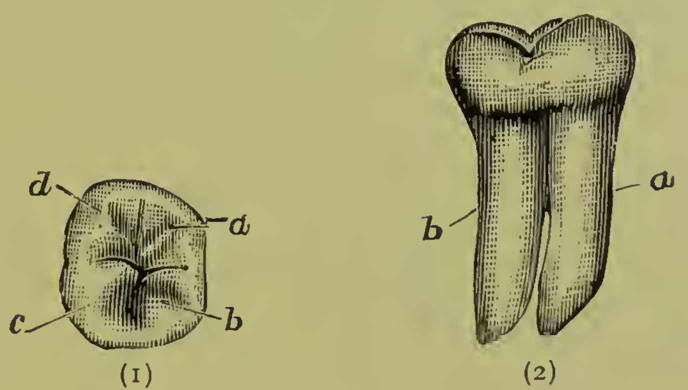


FIG. 38.

(1) Right Lower Second Molar, Grinding Surface. *a*, Disto-lingual cusp ; *b*, mesio-lingual cusp ; *c*, mesio-buccal cusp ; *d*, disto-buccal cusp.
(2) Left Lower Second Molar, Lingual Surface. *a*, Anterior root ; *b*, posterior root. (Note the convergence of roots.)

also squarish in shape, and is surmounted by five cusps, two towards the tongue, two towards the cheek, and one placed at the distal surface between the posterior buccal

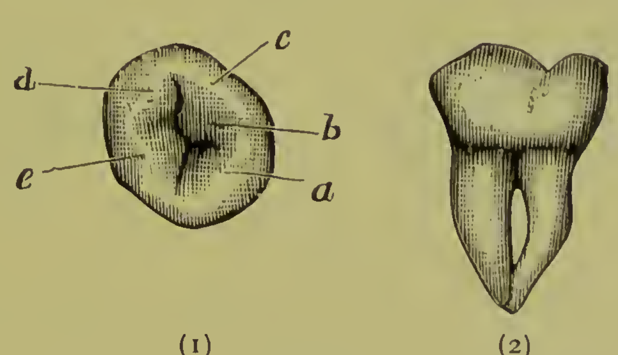


FIG. 39.

(1) Left Lower Wisdom, Grinding Surface. *a*, *b*, *c*, *d*, *e*, Five cusps.
(2) Right Lower Third Molar, Buccal Surface.

and lingual cusps. It has two roots, flattened antero-posteriorly, the anterior being the larger (Fig. 37). They are curved downwards and backwards.

Second Lower Molar.—This is similar to the first, except that it has only four cusps (fifth absent), and the roots are not so divergent (Fig. 38).

Third Lower Molar (*Wisdom*).—This has, as a rule, five cusps, and, like its neighbours in the upper jaw,

FIG. 40.—TEMPORARY TEETH.

the roots are fused into one, and are subject to a great number of varieties in shape. The concavity of the molar roots always looks backward (Fig. 39).

THE TEMPORARY, DECIDUOUS OR MILK TEETH.—These are very similar to the permanent teeth anatomically, but have certain peculiarities, which are typical. They are smaller than the permanent

teeth, their molar roots are more divergent, in order to admit of the crowns of permanent bicuspids, their necks are very constricted, and the enamel covering of the crown terminates abruptly at the neck by turning upon itself, forming a well-marked ridge. They have a perpendicular implantation in the alveolus.

The first upper molar has three cusps, the second upper molar has four cusps, the first lower molar has four cusps, the second lower molar has five cusps (Fig. 40).

A knowledge of these anatomical details, besides being necessary, to a large extent, in a surgical point of view, might be useful in cases of medico-legal inquiry.

CHAPTER IX.

EXTRACTION.

The extraction of teeth cannot be performed with any success unless the operator has made himself thoroughly acquainted with the anatomical shape, number and position of the root or roots of the teeth. If this knowledge has been gained, the choosing of instruments, their application to the teeth, and the mode of dislodgment, follow as a comparatively easy matter. I may say in passing, as a word of encouragement, that the most expert operators sometimes come to grief in the extraction of teeth, and find difficulties they did not expect. But these difficulties are few, and usually can be accounted for by some abnormal shape or position of the tooth. Such contingencies occasionally occur in the experience of dental operators, but if there be given a normally-shaped tooth and a properly constructed instrument, then I may safely say that the removal of a tooth from its socket can be performed without fear, and free from any unfortunate casualty, at least as far as the breaking of the tooth is concerned. There are many other accidents that might occur. It is unnecessary to enumerate them

all. But the three which occur most frequently are: fracture of the jaw or part of the jaw, dislocation of the jaw, and the chance of the tooth slipping from the instrument and lodging in the trachea. The last is the most dangerous contingency, especially when the patient is in the recumbent position and is under an anæsthetic—particularly when the anæsthetic is chloroform. I would here remark, and emphasize my remark, that where more than one tooth is to be removed, be sure the one is safely outside the patient's mouth before proceeding with the next. Never be in a hurry. Never try to accomplish more than the eye can follow or the hand perform. Take carefully into consideration all possible contingencies, and concentrate your entire attention on what is to be done. Be sure to select the right instrument, get the patient into a proper position, and apply the forceps to the tooth in such a manner that the operator is at no disadvantage and is not made to be or to appear awkward. Assure the patient of the necessity of keeping steady. Then let the operation be based upon the following principles, and the troubles of both patient and operator will be minimized.

In ancient medical history relating to dentistry, we read of a teacher exhibiting to his students a forcep made of lead, exhorting them to place so much value on a tooth that it should not be extracted except by means of such an instrument. It was good teaching, and his figurative lesson is that of the present day.

I feel convinced that the science of dentistry will reach such a point that, except perhaps in cases of irregularity, it will be quite unnecessary to remove teeth until we arrive at the seventh stage of life, when senile atrophy may demand their extraction. In that case this operation could be performed by means of the ancient leaden forceps.

There are many instruments which have become obsolete in this 'faddy' age, but which, when understood and used in the proper way and at the proper time, are far in advance of many of the so-called 'improved' new methods and appliances.

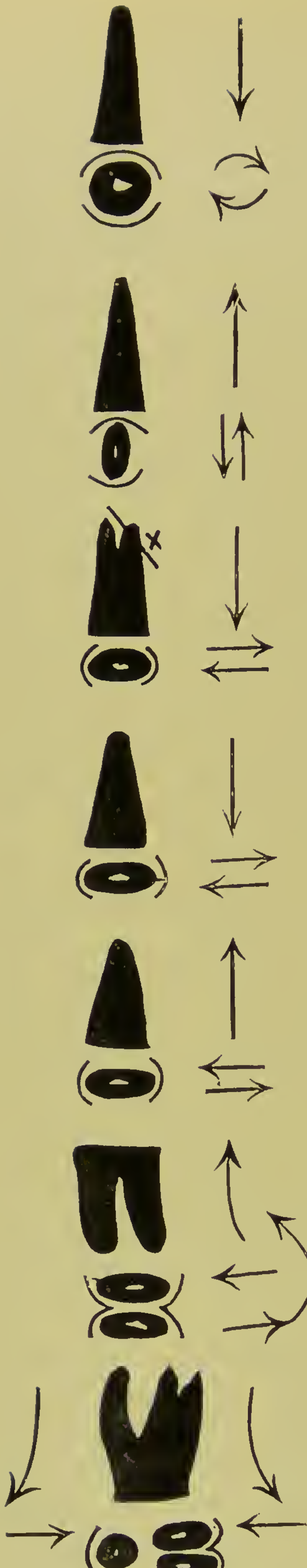
Taking the tooth-key as an example, it will be found that it has almost died out, and is considered by many to be useless and dangerous ; yet, with care and by taking directions from those who have used it all their life as to how it should be applied, there was and is no better instrument for certain conditions, and it has succeeded in many cases when forceps, etc., have utterly failed.

Then, again, practitioners went to the other extreme, and the custom was that, whenever a tooth was bad, or even in many cases merely *looked* bad, it was removed, and no attempt was made to save it. This state of affairs became so recognised by everyone that the dentist was called by the very appropriate name of 'tooth-puller.' But this fashion is also passing away, and we are again returning to the old idea of retaining these teeth as long as possible, by subjecting the offending tooth to treatment.

I draw attention to these facts in order that, when consulted by anyone for toothache or symptoms of pain in the vicinity of the tooth, much discretion should be exercised as to the condition of affairs, and a careful decision made as to what should be done, not coming rashly to the conclusion that the tooth should *come out*, but, if from its appearance or the symptoms given there is a chance of its preservation, giving it that chance, and not condemning it until the last has been done to save it. But if the conditions of the case are such that the removal of the tooth would be best for the patient, then be prepared to undertake the operation. If otherwise, let the patient consult a dentist as to the probability of saving the tooth.

In endeavouring to describe the mode of applying the forceps to teeth and that of their removal, I do so under reservation. I do not wish my statements to be taken as absolute. There may be many other methods of extracting teeth which are taught by dentists, and yet are unknown to me. But whatever I shall say in connection with tooth extraction is the outcome of my own experience, and is what I have taught for years, and have found quite sufficient for all practical purposes.

The teeth are planted in the alveolar process, which is composed of two plates of bone, divided into crypts by septa, passing from one plate to the other, and taking the form of the root enclosed. The outer plate



2nd. Traction directly downwards. 1st. Rotation.	*Upper.* Central and lateral incisors; canines.*
2nd. Traction directly upwards. 1st. Antero-posterior movement.	*Lower.* Central and lateral incisors and canines.
2nd. Traction directly downwards. 1st. Lateral movement (very little).[x]	*Upper.* First bicuspid.
2nd. Traction directly downwards. 1st. Lateral movement.	*Upper.* Second bicuspids.
2nd. Traction directly upwards. 1st. Lateral movement.	*Lower.* First and second bicuspids.
3rd. Upwards and outwards toward tip of the shoulder. 1st. Tilt inwards. 2nd. Tilt outwards combined with 3rd.	*Lower.* Molars.
2nd. Downwards and outwards. 1st. Tilt inwards.	*Upper.* Molars.

FIG. 41.

First movement for periosteal disconnection. Second movement for dislocation. The thin lines round roots indicate position and shape of blade-points.

* Slightly antero-posterior.

is much thinner than the inner, except in the case of lower wisdom teeth. In their case the outer plate is strengthened by the *ext*-oblique line or ridge, and hence the inner plate is thinner. The alveolar process is subservient to the development of the teeth, and would not be there were there no teeth. On removal of a tooth, the alveolar process disappears by absorption, there being no more use for it. These two facts are of great moment in the extraction of teeth, and I shall refer to them again.

There are certain teeth which have one root, some have two roots, others have three roots. To meet these peculiarities there are three, and only three, forms of blades of instruments in the entire stock of dental forceps ever made; any deviation from these three forms is merely to suit circumstances and peculiarities that may have occurred, but they can all be resolved into the original forms. One may come across many curious forceps for tooth extraction, but the peculiarities of these are almost altogether in the handles, which have been altered to fit certain hands and to suit various styles of operating. But what I am desirous of drawing attention to is the forms of blades, which can never alter. There are three standard root-formations, both as regards number and position in the jaws, and to meet this arrangement there must be three standard forms of blades. Such being the case, any departure from these three forms must necessarily be wrong, and cannot possibly fit the teeth.

Whenever you have a tooth with a single root present, or a multiple-rooted tooth having one of the roots isolated, then it will be apparent that the point of the blade must be formed in such a manner as to grasp this root, so that the free edge will not impinge on it. Such a point I shall call round—thus, ∩ (Fig. 41)—in contradistinction to the other condition, viz., that whenever you have two roots placed together in an antero-posterior position, you must have a pointed blade to go between these two—thus, /\ (Fig. 41). This form I shall designate as 'pointed' blade. The three standard forceps are made up from these two forms of blade-points, the one having a double rounded edge, the other a rounded blade on one side and a pointed blade on the other, and the third a double-pointed blade.

I shall pause here for a minute and ask my readers to consider well these forms of blades, the combination of which constitutes the three standard forceps used in dental surgery, as this is the first stage in unravelling the mystery of successful tooth extraction. It can be easily understood that if a pointed blade be applied to a single root, or if an attempt be made to place a rounded blade between two roots lying antero-posteriorly, the effect will be very much the same as if you applied a pair of sharp pliers, which, when pressure is brought to bear, are liable to slip instead of grasp. Using a forceps not adapted to the form and position of the root or roots of the tooth to be extracted is the cause of a great many distressing failures.

In order to lessen the severity of the extraction of a tooth, and to minimize the chance of fracture of its root or roots, it will be evident that any force that you may apply should be in a line where there is least resistance. The two main forces we have to contend with are adhesion and cohesion. In the first place, we have to disconnect the periosteal attachment; then, in the second place, we have to dislocate the root from its socket. Now, the anatomical shape and position of the root or roots will enable us to overcome these two difficulties—as, for example, a round root should be rotated, or a flat root should be moved at right angles to its flattening, or, again, a curved root should be moved in the circle of which it forms a segment (Fig. 41). Then, the patient should be placed as low as possible when removing lower teeth, and as high as possible when removing upper teeth, so as to increase in the one case your lifting power, and in the other your traction downwards. Again, the patient's head must be kept steady. This is done by using the fingers of the left hand, which must be placed according to the particular tooth you are going to remove. In the case of removing lower teeth, the lower jaw should be depressed as low as possible, and in the case of upper teeth the head should be thrown well back.

Before I pass to the consideration of the mode of extraction of each tooth individually, I may here remark upon the manner of holding dental forceps while extracting. This can be done in a few words. All forceps used in dental surgery, without one excep-

tion, are held in the same way—viz., obliquely across the fingers, with the thumb above (Photo 1). To open the blades, put the point of the ring-finger and the little finger between the handles and slowly open the hand, holding the handle nearest the palm firmly fixed between the index finger and thumb, the middle

PHOTO 1.

finger being used to check the distance required (Photo 2). After having seized the tooth, remove all fingers from between the handles and grasp the instrument as shown on Photo 3. Upon no account allow any finger to be between the handles of the forceps during the extraction of teeth.

Photo 2.

Photo 3.

For extraction purposes I will divide the thirty-two teeth into three classes: those that have one root, those that have two roots, and those that have three. Of the thirty-two teeth, twenty have single roots, six have two roots, and six have three roots (Fig. 41). All the incisors, canines, and bicuspids, upper and lower, have single roots, except the upper first bicuspid, which has its root usually bifurcated (Fig. 41), but which, for all practical purposes, has only a single root. But I would request you to remember this peculiarity of the upper first bicuspid, as I shall refer to it again when describing the mode of extracting it.

The lower molars have two roots (Fig. 41); the upper molars have three roots (Fig. 41). The main difference between these respective molars, as far as the roots are concerned, is a matter of divergence, the first molars having divergent roots, the second being closer together, while in the third or wisdom molar we find the roots are usually fused into one, forming, to all external appearance, a single cone-shaped root; but on transverse section we find three root-canals, and it is by these that we count the number of roots (Fig. 41).

As it is frequently the case that decalcification extends to a part of the tooth lying deeper than the neck, it is evident that the part to be grasped by the forceps must lie beyond this point, or, in other words, the part to be seized by the forceps must be strong enough to withstand the force necessary for its extraction.

It is often a matter of great difficulty to thrust the forceps beyond this point owing to the dense consistency

of the gum tissue, also the hard unyielding alveolus; but it is necessary in many cases to go beyond this point before a sufficiently sound part is reached, when the tooth should be grasped firmly but cautiously.

In placing the blades of the forceps in such a position, great care must be exercised, so that the alveolus may not be grasped, which would increase the difficulty of extraction, and might cause extensive laceration and consequent shock.

The periosteal attachment of the roots is so great, and the adaptation of the socket to the roots is so perfect (with complete exclusion of air), that their dislocation by means of a perpendicular force *only* is practically impossible, and, if attempted, would produce great shock even to remote parts.

When part or all the crown of the tooth remains intact, extraction ought always to be performed with forceps. Five pairs of forceps will be found sufficient for most purposes, but you must have five.

These are: a straight pair (Fig. 42); a pair with the blades bent nearly at right angles to the handles (Fig. 43), having rounded blades, both of which will be required for upper and lower roots and all teeth with single roots; one pair adapted for lower molars, with double pointed blades to go between their roots, which lie in an antero-posterior position (Fig. 45); and two pairs for the upper molars—one for the right and one for the left side (Fig. 47)—having a rounded blade on one side and a pointed blade on the other, to meet the position of the three roots, one being placed towards the palate and the

other two in an antero-posterior position towards the cheek (Fig. 41). It will be evident that in the case of upper molars, the position of the roots being reversed, it will be necessary to have a corresponding pair, as the forceps that would fit one side will not fit the other.

With this number of forceps properly constructed, almost any case of extraction may be undertaken where forceps can be used at all. But there are cases where forceps are unserviceable. In many instances where roots are causing irritation and require removal, they are so far decayed as to be altogether beyond the reach, or so soft as not to allow of the application, of a grasping instrument. In such cases we must fall back on what is called the 'elevator.' This most useful instrument exists under a variety of modifications; but I consider that the most serviceable form of elevator extant is one constructed by my father, which has the advantage, apart from its leverage power, of adapting itself to any part of either jaw without the instrument being changed (Fig. 48).

The principle of the elevator is that of a lever, at the extremity of which there is a flat-pointed blade. This is passed down between the root to be removed and a sound tooth, either in front or behind, using the tooth as a fulcrum. The great point to be attended to in using this instrument is, that one must be very careful that it does not slip, as in that case considerable damage might be done to the cheeks, tongue, or other structures within the mouth.

Another instrument, formerly more used than it now

is for extraction, is the 'Key.' This instrument, from the immense power possessed by it, is liable to abuse in its application; but when carefully handled and restricted to such cases as really demand its use, the 'key' is of very great service, and to discard its employment altogether would be to give up an instrument which, in certain cases, could not for simplicity and efficiency be replaced. The cases in which the 'key' is principally useful are those in which the forceps are in danger of breaking down the remainder of the tooth without obtaining a sufficient hold for its removal; or when, on the other hand, the elevator would be applied at a great disadvantage for want of sufficient purchase—in such a case, for example, as that of a lower molar tooth requiring removal, which is not only firmly impacted in the jaw, but is tightly fixed between the adjoining teeth, the case being still more aggravated when the decay has been extensive and deep on the inner side, while the outer wall is tolerably sound. In such a case, by fixing the claw on the sound side of the tooth and turning it in the opposite direction, the tooth will, in most instances, be removed more easily by the 'key' than by any other instrument.

I repeat again what I have already said, that if attention is paid to such matters as the form of the tooth, etc., the part where it is seized, the direction in which it is removed, and the construction of the instrument employed, you may then take it as certain that whenever the tooth is felt to start, even slightly, from

its attachment, all the severity of the operation is over.

In extracting teeth or roots, the operator should always stand on the right side of his patient, except in the removal of lower incisors and canines. When using the 'hawk's-bill' forceps for lower right bicuspids and lower right molars, let him stand on the left side.

Have your feet sufficiently far apart to give steady support to your body, and keep the body in such a position that you will have a full view of what you are doing, and not in any way obscure the light. Always have sufficient light, and, if possible, never operate by artificial light, which is apt to throw shadows, and thus lead to mistakes. Always have a basin or spittoon handy for the patient to use, and keep some tepid water ready. Never give cold water, except in cases where you may have excessive bleeding, as the shock of cold water often produces considerable pain.

CHAPTER X.

EXTRACTION (*continued*).

To remove the Central and Lateral Incisors from the Upper Jaw (Photo 4).—Hold the forceps as directed,

PHOTO 4.

and apply the blades well up below the free surface of the gum, having the back of the hand facing outwards. Seize the alveolus containing the root of the tooth to

be removed between the index-finger and thumb of the left hand, the three other fingers resting on the face gently but firmly. This allows of three precautions: first, you can feel when the tooth is moving in its socket (not the forceps moving on the tooth, as it does occasionally); second, it keeps the patient's head steady; and third, it acts as a counter-traction when dislodging the tooth.

Slightly rotate the root in its socket; then apply traction directly downwards and forwards.

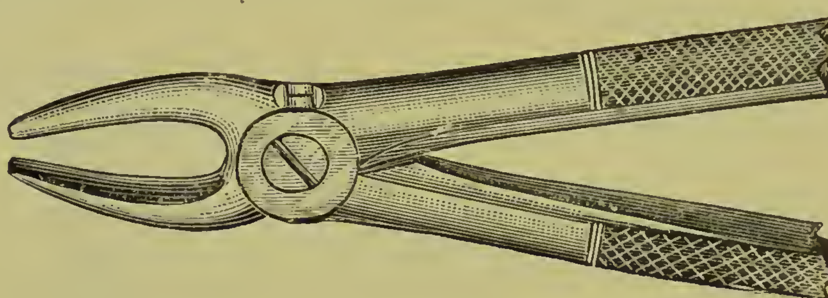


FIG. 42.

1. Rotation, because it has a round-shaped root (Fig. 41).
2. Directly downwards, because it has a straight root (Fig. 41).
3. Forwards, because the outer plate of the alveolus is the weaker, and will more readily give.
4. Use a straight forceps with double rounded blade (Fig. 42).
5. Stand on the right-hand side of the patient.

To remove the Two Upper Canines (Photo 4).—Seize the alveolus corresponding, in the same manner as with the incisors. Hold the forceps as directed, and apply the blades well up below the free surface of the gum.

Apply slight antero-posterior movement with very

slight rotation ; then extract directly downwards and forwards.

1. Antero-posterior movement with slight rotation, because the root is slightly compressed laterally.
2. Directly downwards, because it has a straight root.
3. Forwards, because the outer plate of the alveolus is the weaker.
4. Use a straight forceps with double rounded blade (Fig. 42).
5. Stand on the right-hand side of the patient.

To remove the Lower Central and Lateral Incisors (Photo 5).—Seize the alveolus containing the root between the index-finger and thumb of the left hand, and apply the forceps well down below the free surface of the gum, holding the forceps as directed, with the back of the hand facing forwards.

Forcibly carry the tooth outwards, at the same time directly upwards.

1. Outwards, because the roots are flattened laterally, and the outer plate of the alveolus is the weaker (Fig. 41).
2. Directly upwards, because they have a straight root (Fig. 41).
3. Use straight forceps with double rounded blades (Fig. 42).
4. Stand on the left-hand side of the patient, the right hand being held perpendicular, and the forearm directly in front of the patient's face.
5. On no account use rotation.

To remove Lower Canines (Photo 5).—Seize the alveolus between the index-finger and thumb of left hand, the other three fingers being placed underneath the lower jaw in order to steady it. Apply the forceps as before well underneath the gum-level, with the back of the hand to the front.

PHOTO 5.

Forcibly carry the tooth forwards with almost no rotation, and at the same time directly upwards.

1. Forwards, because the root is flattened laterally and the outer plate of the alveolus is the weaker (Fig. 41).

2. Directly upwards, because it has, as a rule, a straight root (Fig. 41).
3. Stand on the left-hand side of the patient, and let the position of your fore-arm be the same as when removing lower incisors.
4. Use a straight forceps with double rounded blades (Fig. 42).

PHOTO 6.

Upper Right and Left Bicuspids are removed in the same manner (Photos 6 and 7), with three exceptions: First, the first bicuspid on either side should have less lateral movement applied than the second, owing to

the bifurcated root, as there is liability to split off one of the forks (Fig. 41); second, on applying the forceps to left bicuspids, have the back of your right hand turned outwards, and in removing upper right bicuspids have the palm of your right hand also turned outwards; third, on removing the upper left bicuspids, have the

PHOTO 7.

corresponding alveolus between the index-finger and thumb of the left hand, and on removing upper right bicuspids, lift the corresponding lip by means of the thumb of the left hand, having the four fingers resting on the face.

Hold the forceps as directed, and apply the blades well underneath the free surface of gum; then use

forcible lateral motion and traction directly downwards and outwards.

1. Lateral motion, because the roots are flattened in an antero-posterior direction (Fig. 41).
2. Directly downwards, because the tooth has a straight root (Fig. 41).
3. Outwards, because the outer plate of the alveolus is the weaker.

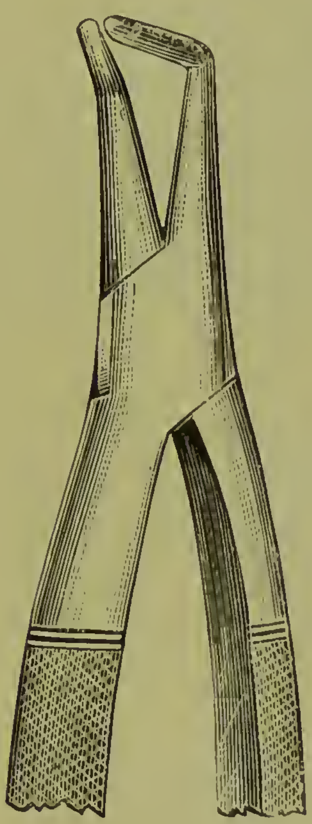


Fig. 43.

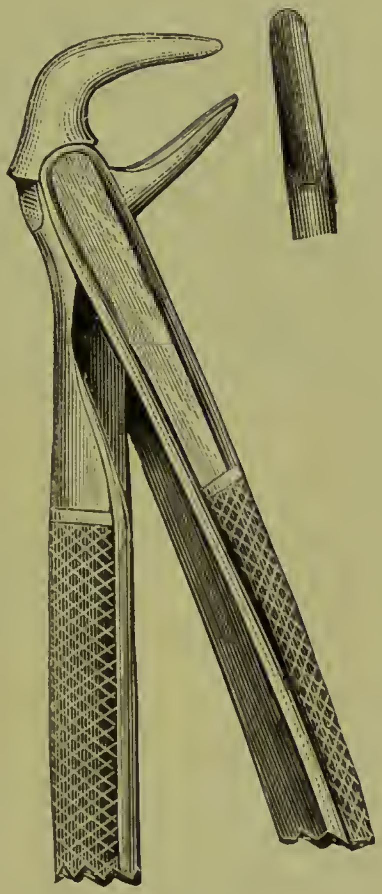


Fig. 44.

4. Use a double round-pointed-bladed forceps, with, if possible, always a straight handle—such an instrument as is used for incisors (Fig. 42).
5. Stand on the right-hand side of the patient.

Extraction of the *four lower bicuspids* (Photos 8, 9, 10, and 11) is exactly similar to that of the upper, except that your traction is directly upwards and outwards.

There are two kinds of forceps for lower bicuspids. One has the blades bent at nearly right angles to the handles (Fig. 43); the other is applied at right angles to the lower jaw, and is called the 'hawk's-bill' forceps (Fig. 44). Of course, they both have similar round-pointed blades.

To apply the ordinary right-angled forceps to lower left bicuspids, use the index-finger of the left hand to hold out the cheek in order to improve the view (Photo 8). Apply the right blade of the forceps to the neck of the tooth to be removed on the buccal side. Then hold it there while you bring the index-finger of the left hand over to the tongue, which you keep out of the way while you apply the left blade to the inner side. Place the point of the index-finger on the top of the forceps, and, with its assistance, press the blades well down underneath the free surface of gum, keeping the finger there till the completion of the operation (Photo 8). The main reason for placing the finger on the top of the forceps, apart from the power thus given of pressure home, is to protect the upper teeth from a blow, which might occur if the tooth left its socket too suddenly. In removing lower right bicuspids—an operation which is precisely similar to that of removing left bicuspids (Photo 9), though the application is slightly different—use the index-finger of the left hand to curtain back the cheek while you apply the right point of the blade to the

PHOTO 8.

PHOTO 9.

PHOTO 10.

PHOTO 11.

inner side of the tooth, and bring the left blade of the forceps to the outer side of the tooth, still keeping the finger on the cheek. Then place it as before on the top of the forceps, and complete the operation in the same manner as in the case of the left bicuspids (Photo 9).

As to using the 'hawk's-bill,' its application to the tooth is the same as in the case of the ordinary forceps, but it is applied at right angles to the jaw.

To remove Lower Left Bicuspids with the Hawk's-bill Forceps (Photo 10).—Place the index-finger of the left hand on the cheek, and the middle finger on the tongue, having the thumb underneath the lower jaw. By this means you expose the tooth to full view, and at the same time steady the jaw. Stand on the right-hand side of the patient.

In removing *Lower Right Bicuspids* with the hawk's-bill forceps (Photo 11), stand on the left-hand side of the patient, facing forwards, and apply the forceps at right angles to the jaw, passing the right arm over the patient's head. In this case, place the thumb of the left hand on the tongue, and the index-finger in the cheek, with the remaining fingers underneath the jaw.

1. Lateral motion, because the roots are flattened antero-posteriorly (Fig. 41).
2. Directly upwards, because the root is straight (Fig. 41).
3. Outwards, because the outward plate of the alveolus is the weaker.

The *Lower Molars* have two roots lying in an antero-posterior position, having a distinct curve (in normally-shaped teeth), which is downwards and backwards. It is this curve that is the main guide in the dislocation of these teeth.

Having the roots placed in an antero-posterior position, it will be seen that it is necessary to have a

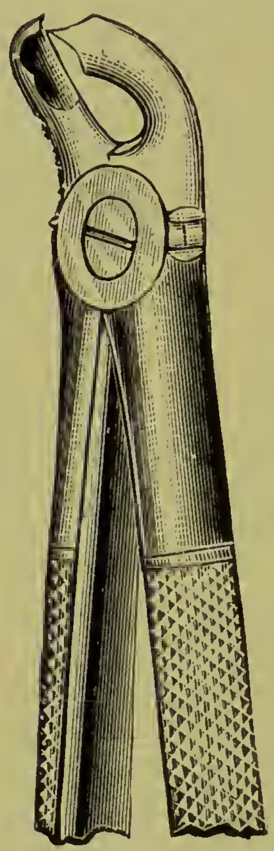


Fig. 45.

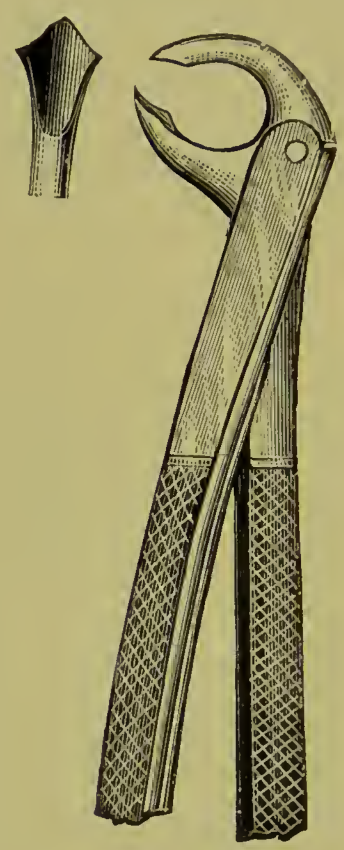


Fig. 46.

sharp-pointed blade to go between the roots on one side, and the same on the other (Fig. 41). And let it be distinctly remembered that, when removing lower molars, one should have an instrument with double sharp-pointed blades, no matter what the shape of the handles may be.

There are two kinds of forceps for removing lower molars, as in the case of bicuspids—viz., a pair having the blades at an obtuse angle to the handles (Fig. 45), and the hawk's-bill forceps, which is applied at right angles to the jaw (Fig. 46). The application of these instruments to the teeth is precisely similar to the mode described for lower bicuspids.

After applying the forceps to the tooth, having the point of the index-finger of the left hand on the top of the instrument when using the right-angled forceps (Photo 13), stand well over the patient; this will increase the lifting power. Then the first movement will be a distinct turn inwards; this disconnects the periosteal attachment of the buccal side of the roots. Then upwards and outwards towards the tip of the patient's shoulder; this disconnects the attachments on the inner side, and completes the circle of which the roots form a segment (Photos 12, 13, and 14).

The application of the hawk's-bill forceps is the same as in the case of bicuspids. Stand in the same position, and use the fingers of the left hand in a similar way. Complete the operation in the same manner as with the right-angled forceps—viz., a tilt inwards—forcibly lifting the tooth upwards and outwards towards the tip of the patient's shoulder (Photos 15 and 16).

In removing *Upper Molars* the mode of operation is the same on both sides. The upper molars having three roots—two placed in an antero-posterior position on the buccal side, and one towards the palate (Fig. 41)—it is evident that it will be necessary to have an instrument

Photo 12.

Photo 13.

Photo 14.

Photo 15.

with a sharp-pointed blade to go between the two roots on the outside, and a round-pointed blade to grasp the single root on the inside (Fig. 47). The roots of upper molars are very divergent, converging as they go backwards. The buccal roots are practically straight,

Photo 16.

but the palatal fang has a distinct curve inwards and upwards, and this palatal root is the main guide to the dislocation of upper molars.

Stand on the right-hand side of the patient in both cases. Seize the alveolus of the tooth to be removed

between the index-finger and thumb of the left hand, having the three remaining fingers resting on the face (Photo 17). There may be found a difficulty in thus seizing the alveolus on the right side, and if so, use the index-finger of the left hand to lift the cheek clear

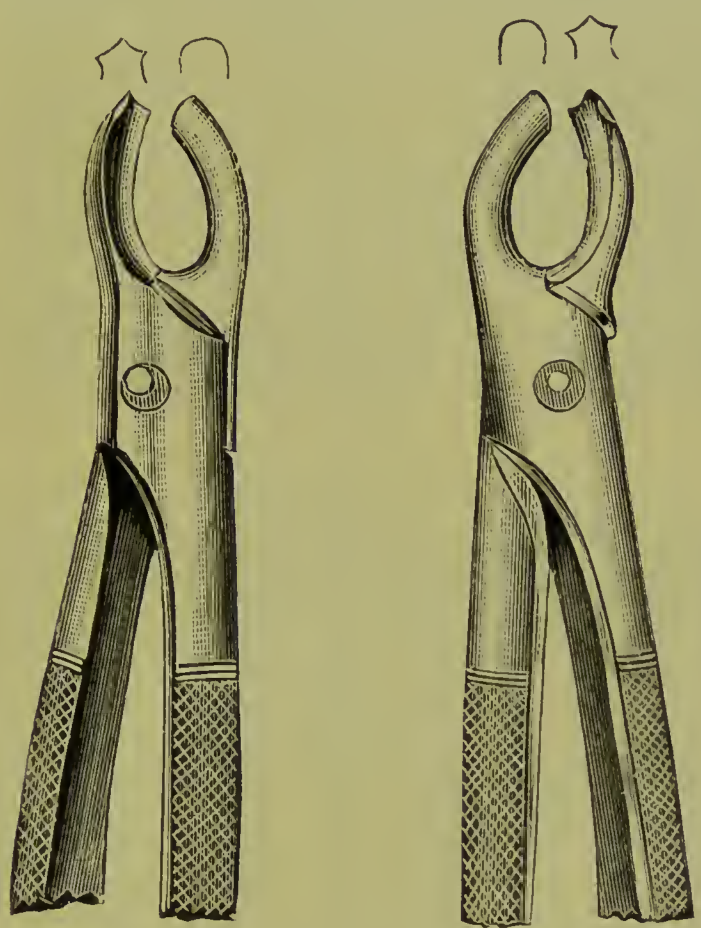


FIG. 47.

of the tooth and alveolus, having the remaining fingers resting on the face (Photo 18).

Apply the forceps well underneath the level of the gum, being sure that the sharp-pointed blade of the forceps has been placed well between the buccal roots. Then, by a steady movement inwards, it will disconnect

Photo 17.

Photo 18.

the attachment of buccal roots; then traction downwards and outwards. The second movement must be done in a circle, of which the palatal fang forms a segment.

THE ELEVATOR.

1. To remove roots from the upper right side, stand on the right side of the patient, hold the cheek out by means of the index-finger of the left hand, and apply the point of the elevator between the root to be removed and a tooth on either side of it, using it as the fulcrum. If the tooth behind the root be used as the fulcrum, turn the elevator, so as to cause the point of it to

FIG. 48.—ELEVATOR.
Original elevator measures $7\frac{3}{4}$ inches long.

move downwards and forwards; on the other hand, if the tooth in front of the root be used as the fulcrum, then let the point of the elevator be moved downwards and backwards (Photo 19).

2. To remove roots from the upper left side, stand on the right side of the patient, seize the alveolus containing the root to be removed between the index-finger and the thumb of the left hand, and pass the point of the elevator between the root and a tooth in front or behind it. If a tooth behind the root be used as a fulcrum, then turn the elevator so as to cause the point of it to move downwards and forwards. If a

PHOTO 19.

PHOTO 20.

tooth in front be used, then turn the elevator so that the point will move downwards and backwards (Photo 20).

3. To remove roots from the lower right side, stand on either side of the patient. If on the right, keep the cheek out by means of the index-finger of the left

PHOTO 21.

hand while applying the point of the elevator down between the root to be removed and a tooth in front or behind. Let the movement of the elevator be the same as in the upper, according to the tooth taken as a fulcrum, upwards and backwards or upwards and for-

wards. If on the left side, apply the elevator in a similar manner as in the case of using the lower hawk's-bill forceps for this side, having the alveolus containing the root to be removed between the index-finger and thumb of the left hand (Photo 21).

4. To remove roots from the lower left side, stand on either side of the patient, as is most convenient; seize

PHOTO 22.

the alveolus between the index-finger and middle finger of the left hand, the thumb being placed underneath the jaw; pass the point of the elevator down between the root to be removed and a tooth on either side of it, and move the elevator, according to the tooth used as a fulcrum, upwards and backwards or upwards and forwards (Photo 22).

The blade of the elevator being bent at an obtuse angle to the handle, the hand grasping the instrument must be depressed in the case of removal of roots in the lower jaw, and elevated in the upper, so that the blade will be in the same line as the long axis of the root. When it is placed, slight rotatory movement should be applied, in order to make sure that it has gripped. The point of the elevator blade should only be inserted sufficiently deep to catch the top of the root. If it is driven too deep, it will probably lock when trying to turn it. When the elevator has been placed sufficiently deep, let the displacement of the root be gradual. The leverage, when applied, must be in such a way as to secure the blade revolving directly forwards or backwards according to the fulcrum used. In the event of no tooth being present in front or behind the root to be removed, then an artificial fulcrum may be substituted, such as the handle of some convenient instrument at hand. If the root, from its position and condition, be easy of removal, then it can invariably be dislodged by simply pushing it. As already remarked, always use forceps for extraction of roots if the root will admit of it; but if the root is so placed or broken so far below the level of the gum as to make it impracticable, then the elevator should be used.

In children one often finds very extensive ulcerated sores and bands of mucous membrane connecting the cheek with the gums—a hypertrophied condition of the gum tissue low down on the buccal or labial surface of

the alveolus in the lower jaw and high up in the upper jaw, and the tissues in the immediate vicinity very much inflamed and very painful. This condition can be easily accounted for, and the remedy for it is very simple.

If the lip or cheek that corresponds to the part affected is grasped, you will find, on putting it on the stretch, a protrusion of the apex of the root or roots of a temporary tooth through its outer plate of alveolus. This is brought about by the natural absorption of the temporary root being interfered with, or by an early eruption of the corresponding permanent tooth. The permanent tooth, in trying to find its way to the surface, is met by the root of the temporary tooth, which should have been absorbed synchronously with the advance of the permanent tooth. The permanent tooth must necessarily force its way, which it does by overriding the root by passing either in front of it or behind it, the usual method being that it drives the root outwards. The removal of the temporary root will put matters right at once. This is best done by placing the point of the elevator on the apex of the root, and bringing it outwards through its corresponding band of gum tissue in the line of displacement.

This operation can, as a rule, be done by means of the nail of the finger, a method which in many cases is advisable, as it does not frighten the child so much as if you exposed the instrument to its view.

The condition just described is often allowed to run

its course for a long time, and when one is confronted with a case of long standing, matters look very serious, and the case is often mistaken for one of necrosis. But the explanation of the symptoms is simple, and the treatment is easy.

The extraction of temporary teeth is much the same as in the case of the permanent teeth ; but for the removal of upper and lower molars there should be no sharp-pointed blade on the forceps, as such a blade is apt to pass too far in between the roots and injure the bicuspid below.

The constricted neck and enamel ridge, which is peculiar to the temporary teeth, is the part to be seized by the forceps, not between the roots, as in permanent molars.

Avoid as much as possible the removal of temporary teeth. If the child be in pain from decayed temporary teeth, the insertion of a little soft filling into the cavity, and the prescribing of a slight aperient, will, as a rule, give relief. Of course, if there is protrusion of roots through the alveolar wall, or an abscess is forming from temporary teeth, remove at once. And, again, when there is irregularity in permanent teeth caused by the presence of temporary teeth, *extract*.

The age of the patient should be the first inquiry. This information will act as a guide as to what should be done. When cases of irregularity have to be dealt with, it is necessary to learn the age of the patient, for when that is ascertained it will be known what to expect, and any departure from the normal condi-

tion will be easily understood and put right. If there is more than one root or tooth to remove in children, it is well not to leave the mouth until you have completed the operation. If you leave the patient after the removal of the first piece, the probability is you will not be allowed to return to the second without a great amount of trouble. After removing the first piece, shake it from the instrument, still holding the patient's jaw with the left hand; then remove in quick succession the second or third piece, as the case may be.

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